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THE CHANGING USE OF MATERIALS IN

CONSTRUCTION OF THE VERNACULAR THAI HOUSE

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A thesis submitted for the degree of Doctor of Philosophy

University of Bath

Department of Architecture and Civil Engineering

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Abstract

The evolution of vernacular houses throughout history has been a response to factors such as geography, climate, craftsmanship and materials. The use of materials is considered to be one of the major principles that form vernacular houses. Before the introduction of concrete during the past few decades, wood, bamboo and grass thatch were the primary available materials for vernacular houses in Thailand. Particularly, the traditional houses in the central Thailand, which were found since the 13th century, have been one of the most admired models. Due to the processes of modernization, the existing traditional Thai houses have been changed from tradition to contemporary. This study focused on three types of vernacular houses in the central Thailand: the traditional Thai house; the transforming Thai house; and the reproduction Thai house. This study examined the features in these contemporary vernacular houses which have been influenced by changing use of materials and construction methods.

The study was conducted by examining the changes of vernacular houses in three locations in Ayutthaya province: the urban district village, the rural village, and the motorway buffer area. Data were collected with the uses of materials, construction types, and features of construction elements. The data were analyzed and discussed through typological analysis and constant comparative analysis to reveal the differences of vernacular houses among the studied locations.

The findings show the ways in which vernacular traditions have been integrated with modern influences. The development and change of use of materials are indicated for reflecting the evolution of vernacular Thai houses. The results reveal that, from the earliest period of modern Thai industry, contemporary vernacular Thai housing has been influenced by materials available and construction methods employed. Industrial materials have been used to improve the performance and change the appearance of the traditional Thai houses. Because of the availability of early industrial materials and construction methods, the transforming Thai houses will therefore continue to be sustained by their current owners. Traditional and modern materials are applied to the reproduction Thai houses with updated construction techniques. Vernacular Thai houses are confirmed as a continuous process and

appreciated in the context of the present. The results of this study offers some clues to support an understanding of living heritage, and thus promoting conservation of vernacular buildings in Thailand.

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Chapter 1
Introduction

1.1 Background

The development of vernacular architecture throughout history has been a response to their environmental contexts. Materials are commonly considered to be one of the defining features of vernacular architecture and the properties and potential of materials influence the structure, building components and construction methods. Indigenous style and building traditions have evolved from the use of available materials.

Historically, the Thai vernacular house was built mainly with forest-based materials, and this remained the case prior to the occurrence of wood scarcity in the early 20th century. The Thai houses were typically constructed using timber frame raised on pillars. Some houses which had floors above accessible height used the ground floor for multiple purposes such as open living space in the daytime, animal shelter at night and boat mooring site during times of flooding.

During the 13th and 14th centuries, a distinctive vernacular type of house called *traditional Thai house* was developed in the central region (Figures 1.1.1 and 1.1.2)[1]. Horayangkura (2001) suggested that it was a further development of the *Lanna Thai house*, found in the northern region before the 13th century. This type of the traditional Thai house became widely established due to its aesthetics and practicality. The construction elements were made from wood, principally teak. However the use of wood declined in the early 20th century due to various factors including the shortage of plant materials and the introduction of industrialized materials such as concrete and corrugated metal sheet (Jaijongrak 2000).

Since the beginning of Thai industry movement such as the establishment of the Thai industrial Division in 1933 and the Department of Industry in 1941, change in Thai vernacular tradition has increasingly developed. These have stimulated more rapid type of change than evolution during the pre-industrial period (Strike 1991, 1988).

[1] In this study, all images or drawings created by the author are not acknowledged. The images or drawings created by other sources are attributed.

Figure 1.1.1 A traditional Thai house in the King Rama II Memorial Park in Central Thailand

Figure 1.1.2 A traditional Thai house in the rural village in Central Thailand

Traditional Thai houses are considered by Thai people to have heritage value and to be a symbol of Thai architectural identity. Jotisalikorn (2002) confirmed that the most enduring icon of Thai style and design is the *traditional Thai house*. Although few *traditional Thai houses* have been maintained in their original condition, most of those owned by local residents are being transformed from a common archetype (Figures 1.1.3 and 1.1.4). These changes can bring about advantages and drawbacks. One advantage is protecting and extending the life of traditional vernacular buildings while a significant drawback is that an uncontrolled change causes adverse impacts on preservation and conservation. The use of industrialized materials such as corrugated metal sheets, concrete tiles, and steel is

also increasingly regarded as appropriate for contemporary buildings and may be the basis of new vernacular forms (Lewis 1997).

Figure 1.1.3 A traditional Thai house with use of corrugated metal sheet as roof cladding

Figure 1.1.4 A traditional Thai house extended and modified with concrete structures

Local materials are often cited as being the defining features of vernacular traditions, while the use of imported or industrialized materials is considered to be an element of deterioration and loss of value by some conservators. Many scholars considered that buildings using local materials are the only true vernacular buildings (Bowyer 1980, Rice 2003). In contrast, others argue that the import of industrialized sheet materials has both extended the life of many vernacular traditions and protected them at a relatively low cost (Oliver 1997). Davis (2005) supported the need for a new kind of architectural education that pays attention to vernacular traditions integrated with new technologies.

While active protection policies are in place for major monuments throughout the country (Enhancement and Conservation Act 1992), little attention has been paid to dwellings in settlements belonging to ordinary people. A lack of supportive design guidelines and policies means residents have to maintain their houses with heritage value by themselves. Mostly, *traditional Thai houses* have been extended or modified with available resources and limited budgets to accommodate growing families and new living standards (Figure 1.1.5). Over-restoration or uninformed works have been carried out by wealthier residents. To maintain and continue the use of their houses, some residents may change the indigenous features without any guidelines. Due to the rapid changes in the central region of Thailand, surviving *traditional Thai houses* nowadays are confronted with uncontrolled adaptation and the disappearance of vernacular traditions (Figure 1.1.6).

Figure 1.1.5 A traditional Thai house with a modern kitchen as new living standard

Figure 1.1.6 A traditional Thai house extensions with westernized style

This study examines the construction features of Thai vernacular houses that have been influenced by changing materials and construction methods. The vernacular houses considered in this study are *traditional Thai houses*, which have been built or transformed according to various typologies. The starting hypothesis is that changing materials, resulting in changing construction methods, strongly influences either retention or deterioration of Thai construction features. This study relates to an understanding of living traditions which integrate traditional houses with new technological advancement and cultural change.

1.2 Aims and objectives

Three overall aims are as follows:

1. To establish a better understanding of vernacular Thai houses;
2. To present the emerging of the recent types of contemporary vernacular houses; and
3. To change the ways of protection and raise an awareness of vernacular Thai houses in the present context.

The transforming Thai house and the reproduction Thai house are considered by analyzing materials and construction technology currently used in a chosen sample, which have been developed from or related to the traditional Thai house. This research intends to fulfil the aims by the following objectives:

1. To investigate the influence of the change of materials on vernacular Thai houses;
2. To measure the change of transforming and reproduction houses and change of materials with time;
3. To identify and compare distinctiveness of sites in different historic settings;
4. To highlight the relationship between materials, methods of construction and Thai construction features; and
5. To propose ways of sustaining vernacular building traditions and merging between old and new building materials and construction methods.

1.3 Scope

To clarify the scope of this study, the following limitations are as follows:

1. The significant parameters chosen to identify the key feature focus on material and construction aspects, rather than design or other aesthetic aspects;
2. The study is concerned with the vernacular houses which can be traced back to the archetype of the traditional Thai house. These houses would have undergone different process of transformation or be intended to combine the original with the contemporary type, and these will be investigated in this study;
3. The study focuses on single or clustered houses owned by local residents and located in Ayutthaya province.

1.4 Significance of the study

Instead of a preservative approach, the study focuses on the active nature of vernacular buildings. Because vernacular buildings are not resistant to change or could resist for a moment, the study shows how vernacular buildings have changed from an archetype to contemporary models, and adapt to the environment and condition of the twenty-first century.

The study is concerned with the contemporary vernacular houses which have been undergoing transformation in the use of materials. A comparative study is applied for better understanding of similarities and differences among various locations. The uses of materials are the main focus of the study.

The study is composed of two main measurements with time: measurement of change of houses; and measurement of change of materials and construction methods. The measurements are compared among different settings: suburban; rural; and motorway buffer area.

The measurement and the comparison will clearly show suggestions for governors, scholars and villagers. Moreover, the understanding of adaptation of vernacular houses related to materials will benefit the villagers who have merged old and new building traditions. Beyond the finding for the vernacular related practices, it is worthwhile to adapt this knowledge to the architectural design of modern buildings.

1.5 Thesis outline

This report consists of three parts:

The first part clarifies the background of the research and summarizes the theories adopted to understand the vernacular buildings. Two chapters are used to develop this part. Besides this introduction in Chapter 1, at the beginning of Chapter 2, the term ‘vernacular’ building is defined and the studies that have been carried out about this subject are reviewed. Various factors shaping vernacular building are discussed. In this chapter, traditional materials and construction of the Thai vernacular house are reviewed. Uses of materials, methods of construction and Thai construction features are described. Furthermore, the nontraditional materials are categorized by previous studies. Early industrial and contemporary materials are described in detail. Lastly, the previous studies are summarized for understanding the purpose of the study.

The second part explains the methodology, analysis criteria and site selection. The principles of data collection are presented, including the research questions and approaches of the case studies. The survey procedures and results done mostly in 2005 are given in detail: the survey form and the classification of physical appearances. These are followed by the description of statistics used for the two typological analyses: relationship and comparative. In the last part of chapter 3, the research sites and method of selection of the study areas are also discussed.

The third part forms the core of the research. In Chapter 4, the archetype of traditional Thai house, house transformation, and the difference of the transforming and reproduction Thai houses are discussed in terms of their typical physical appearances. The process of transformation and reproduction are discussed by referring to the archetype and time. In Chapter 5, the developments of construction elements are discussed and compared among three locations.

In Chapter 6, the key features of construction elements and quantitative data are discussed by the outline from the transformation and the construction elements in previous chapters. The relations and the significant differences of materials in three locations are presented and supported by statistics, interview and narration. The conclusions and consideration for further study are presented in Chapter 7.

Chapter 2
Literature Review

This chapter aims to clarify definitions relating to vernacular and traditional subjects, and also to review previous studies providing the study backgrounds of vernacular buildings, materials and construction.

2.1 Definition and study of vernacular architecture

The word of “vernacular” usually refers to indigenous, local, and native. Vernacular with regard to the field of architecture means to domestic and functional rather than public buildings (Concise Oxford Dictionary 2004). Rudofsky (1964) called this type of architecture: vernacular, anonymous, spontaneous, indigenous and rural.

Correa (1998) defined vernacular architecture as an organic process. He described the use of the vernacular as not the product of any individual, but that of an entire community, working through its history. Lim and Beng (1998) claimed that the term “vernacular architecture” is one of the most commonly used but least understood terms in the field. They also argued that the term “traditional” and “vernacular” have been used interchangeably.

Oliver (1997) mentioned that most vernacular architecture are dwelling. Vernacular houses are buildings which have been evolved or developed by ordinary people for their everyday living in a particular locality. The forms of these houses have been designed to respond to their environmental contexts. Oliver (1989) stated that vernacular houses are handed down as a heritage from generation to generation. These houses are not fixed to the beginning of their history. They are always changing from traditional forms to contemporary ones in accordance with living activities and value of the residents (Lawrence 1987).

The term “vernacular architecture” has been explained as building activity which is purposely permanent rather than temporary. It provides for the simple activity of ordinary people, which is strongly related to its place, especially through the uses of local building materials (Brunskill 1986).Thus, it is traditional rather than academic in its inspiration.

Vernacular architecture has been a subject of academic interest since the nineteenth-century (Alsayyad 2006; Oliver 1997), particularly after the exhibition of Architecture without architects: A short introduction to Non-pedigreed architecture by Bernard Rudofsky (1964). There have been various studies on vernacular architecture. Some stated the traditional architecture does not go through fashion cycles but is clearly immutable or unchangeable. The origin of its building forms and construction methods is lost in the distant past. Upton (1993) commented about this viewpoint that the study of the field of vernacular architecture has been held back by the limitations of its own assumptions and definitions. He supports the study on vernacular architecture in order to understand vernacular architecture in a new way. Brunskill (2000) showed that an interest in vernacular buildings has been developed through the movement of building conservation. In the past two decades, there have been increasing the courses and research programs with an attempt to reveal its significance in various aspects. Academic and professional interest has been concentrated in documentation, studying and preserving historical and traditional buildings before losing or irreversible alteration of those vernacular houses. Especially, the vulnerability of vernacular traditions under the threat of modern developments has been commonly addressed and used as the main research objective to apply to policy for conservation.

To understand and sustain the vernacular in the twenty-first century, Vellinga (2006) suggested focusing on new and emerging vernacular traditions as well as on enduring ones and on the ways in which they interact and relate to one another. He noted that vernacular traditions have not all vanished, but merged with modern ones to create new manifestations of traditions or localized hybrid forms that better suit current circumstances and requirements. The hybrid features of vernacular architecture within a locality, as Rapoport (1969) mentioned, express its additive quality, unspecialized and open-ended nature. These qualities enable its architecture to accept changes and additions which would visually and conceptually be opposite to scholastic or academic architecture.

Alsayyad (2006) also encouraged scholars of the vernacular to face the world of global communication and supported Oliver's advice about the change in an era of technological advancement and increased communication. Therefore, the study of the vernacular buildings in the twenty first century needs to develop an understanding of

how they have changed and merged with modern traditions to create new hybrid forms with their sensible, appropriate and sustainable.

From the literature review, definition of vernacular houses in this research follows the statements from Brunskill (1986), Rapoport (1969), and Vellinga (2006). The definitions of vernacular building are indicated as follows:

1. Vernacular buildings relate to ordinary people through the use of local building materials;
2. Vernacular characteristics accept changes and additions;
3. Vernacular traditions have merged with modern traditions to create new hybrid forms.

2.2 Vernacular architecture in Thailand

In Thailand, vernacular architecture customarily means to dwellings located in rural areas. For example, the vernacular architecture described by Roonrakwit (1997) includes the hut, the feudal house, the Siamese house and the Chinese shophouse. To gain a broader idea of vernacular architecture in Thailand, more types of buildings, which may be defined to be vernacular architecture, are included in this study. In this respect, it should be considered that some of the formal architectural styles associated with monumental buildings have often become the lexicon of common buildings, and hence can be categorized as vernacular architecture in these days (Figure 2.2.1).

Figure 2.2.1 A monumental building with formal style

Paribatra (2002) stated that one of the vernacular Thai buildings, the *traditional Thai house*, which is representative of 'Thai style', is not a static phenomenon. He described its evolution, from its 13th century heritage, through centuries of development and adaptation, to the present day. From the Sukhothai, Ayutthaya, Lanna and today's Ratanakosin era, he explained the influence from Thai's surrounding neighbors. Built entirely from wood, domestic houses have the capability of being dismantled, moved to a new site and reassembled or rebuilt with adaptation for modern-day use.

2.2.1 Vernacular Thai houses

Roonrakwit (1997) stated that before the 13th century, the features of the vernacular houses in Thailand cannot exactly be determined. However, it can be assumed that most houses in Thailand were traditionally built on high pillars, high-pitch roof using grass thatch as the roofing material. Wood and bamboo are the principal materials for the house, resulting in lightweight construction in this area. The house could easily be disassembled and relocated or reassembled when necessary.

In Central Thailand, houses were normally built along canals or watercourses as linear settlements, reflecting a water-based culture (Horayangkura 2001). Denpaiboon (2001) divided the typology of houses in central Thailand into two types: the structural floating houses on the water (Figures 2.2.2) and houses on stilts situated along the riverbank or on land. Houses on stilts are also categorized into two types: the temporary types or semi-permanent types that were made of bamboo and the permanent types that were made of wood. Most houses in central Thailand usually were usually built on stilts and located along the river shores. This was common scenes of dwellings in this region. However, because of the expanding of construction of motorways and roads, houses are also built along these new communication routes. This has resulted in a major change to the houses by adding walls to enclose the space underneath the house to form interior space at ground level. This, somehow, has made the appearance of two storey houses (Figures 2.2.3).

Figure 2.2.2 Floating house in Bangkok during the 19th century (Source: The Siam Photo Studio)

Figure 2.2.3 A two-storey house in Central Thailand

The house type focused in this research is made mainly with wood because the bamboo houses in Central Thailand are rarely found at the present. A few houses in ethnic group communities show the vast uses of bamboo, which are similar to the bamboo house built in Thai communities (Figures 2.2.4 and 2.2.5). Houses both in etnnic group and Thai communities used to be built all of the construction elements with bamboo except roofing materials.

In addition, a new vernacular type called *shop house* was built in an urban context by Chinese immigrants during the 19th century. Thungsakul (2001) explained that shophouses serve the dual functions of business and family living. An early shophouse is typically wooden construction and forms in a row of uniform dwellings located along a commercial road. The ground floor is used for commercial purposes, while the upper floor is for residential and sometimes used as a warehouse (Figure 2.2.6).

Figure 2.2.4 A house constructed with bamboo and wood in the ethnic group community in Central Thailand

Figure 2.2.5 Bamboo used for walls and roof structures while wood used for beams and columns

Figure 2.2.6 A raw of shop houses in Central Thailand

2.2.2 Traditional Thai architecture with formal style

Horayangkura (2001) noted that formal architecture in Thailand can be categorized into three main periods in accordance with. The first period is Sukhothai. In this first period, formal architecture traditionally used both wood and masonry together. Wood or timber was used for roof and floor structures, while masonry was used for load bearing walls. Although masonry was the main building materials, it created building features as imitating timber construction shape and form.

The second period is Ayutthaya. With the capital of a new kingdom and the first cosmopolitan city of Thailand (named Siam at that time), architecture of Ayutthaya integrated the styles of Dvaravati, Lopburi and Sukhothai periods. The multi-layered roofs were developed and became the typical roof of a Thai temple and the predominant components of Thai architecture (Figure 2.2.7).

Figure 2.2.7 A double-layered roof of a temple in Central Thailand

The third period is Rattanakosin period or Bangkok nowadays. In Bangkok (Ratanakosin) period, formal architecture not only still continued the multi-layered roofs from the Ayutthaya period, but also accepted influences from Chinese immigrants and European domination. In the early 1900s, the highly articulate, multi-layered, high-pitched roofs were used with modern construction. This new form was developed for large-scale public buildings, containing new usage purposes, such as institutional buildings.

2.2.3 Archetype of the traditional Thai house

The archetype of the vernacular houses could be commonly classified through some aspects of building, such as the diagram of the plan, the most common features of the elevation, and decorative details or shape of openings. These aspects could help to define the difference of house features (Pavlides 1997). Vernacular houses are different from place to place. In Thailand, vernacular houses can be classified mainly in accordance with the regions of the country: the Northern, the Northeastern, the Central and the Southern. Among these regions, vernacular houses in the Central are considered to be the most classic (Jotisalikorn 2002). This regional house is sometimes called *traditional Thai house,* and has been found since the Sukhothai period (1238-1368).

Horayangkura (2001) explained that the *traditional Thai houses* have unique features: a steep roof, a raised-up floor on pillars, a semi-enclosed central terrace and a covered veranda, inward sloping walls, tapered windows, an outdoor staircase, a prefabricated wooden structure and enclosing elements.

The *traditional Thai houses* in the central Thailand are distinguished from vernacular houses in other regions with their high-pitched roofs. The roof with the graceful lines of a high-peaked bargeboard, curved at the lower end, and with its ornamented gables are uniquely Thai, especially in terms of architectural refinement and the carpentry work that went into the construction (Figure 2.2.8). To enlarge the house compound, additional structural units are attached to the terrace (Figure 2.2.9).

Figure 2.2.8 A high-pitched roof with graceful lines of a bargeboard

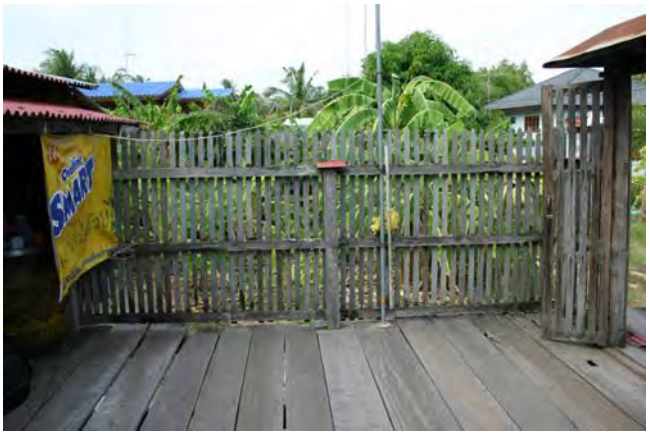


Figure 2.2.9 A central terrace surrounded with wooden screens

The typical Thai house in the central region is made mostly of timber, except for the roof tiles, and compiles together with wooden dowels and pegs, without using nails. Prefabricated walls are used as part of the main feature of the skeleton construction. The carpentry produces very light prefabricated walls throughout, along with small structure members. Consequently, *traditional Thai houses* minimize the usage of materials, expressing an economical form of construction.

Besides those elements, Jotisalikorn (2002) explained further that the *traditional Thai house* also consists of an extendable room. The size of a house varies from a single-family house to a cluster house (Figures 2.2.10 and 2.2.11). The smaller house is normally composed only of a bedroom and kitchen, while the cluster house has possibly up to five or six bedrooms. Every bedroom is arranged along the terrace or veranda, which clustered around the roofless terrace. From the extended family system in Thai culture, additional bedrooms were added as the family size increased around the roofless platform.

Figure 2.2.10 A single-family house with one bedroom unit

Figure 2.2.11 A cluster house with many bedroom units

2.2.4 Contemporary vernacular buildings

Vernacular buildings are not static phenomena. They are always evolving with everyday living of the residents. Lim and Beng (1998) stated that contemporary vernacular is a dynamic development of architectural direction to meet the challenges of rapid urbanization and modernity. In a different view of the trends and changes, Oliver (1987) pointed to the evolving neo-vernacular buildings. He referred to the "Fourth World" people and the indigenous cultures that survive within the industrialized society. The used, recycled and industrial materials are adopted in former traditional contexts.

Some of contemporary vernacular in the northeastern region of Thailand was explained by Thongsakul (2001). His explanation was based on the previous research conducted by Hengrasamee, Phalawattana and Sutthitham (1992). He shows that the contemporary style in the study area tends to imitate the style created by land and property development companies. This contemporary style could be found everywhere in suburban housing projects. The house has a single story or two stories. Its structure enclosed by concrete blocks or masonry walls is built by reinforced concrete. Roofs are built in hip or gable shape covered with concrete tiles or corrugated asbestos cement sheet

As stated earlier in the previous chapter, this research concentrates on dwellings, changed from a *traditional Thai house* to a *transforming Thai house* (Figures 2.2.12 and 2.2.13). To understand more discussions about Thai vernacular houses, the key terms of the other type of contemporary vernacular houses will be defined in this study such as a *reproduction Thai house* (see Chapter 4).

Figure 2.2.12 A transforming Thai house in the studied area

Figure 2.2.13 A reproduction Thai house in the studied area

2.3 Materials and methods of construction

2.3.1 Traditional materials

Up to the middle of the 19th century, the built environment in Thailand was still mostly constructed out of locally produced or industrial materials. The main materials used for houses were bamboo and timber, mostly hardwoods such as teak. Stone and brick were used for temples and palaces. Brick and timber were used for Chinese shop-houses. Although houses of immigrants and important persons of royal lineage were built with brick and stone, houses of ordinary people have continuously used timber as the main material. The change in the early 19th century began in the roofing materials, as clay or terracotta tiles supplanted vetiver grass.

Vernacular building can be determined by climate, materials and function (Pavlides 1997). Lim and Beng (1998) stated that vernacular structures such as indigenous shelters or dwellings are well adapted to the extremes of climate and their particular environmental setting. It is clear that the same understanding of traditional architecture considers some common features such as being indigenous to a region, using local materials, low level of technology, and designed and developed by a community, not an individual or experts.

According to the broadest definition of vernacular constructions, buildings are built not only with local materials but also with available materials. Since the 1960s, Southeast Asian towns have undergone rapid development (Oliver 1997). The uses of imported or industrial materials have been spreading widely into the areas that can be accessed by road. These new materials have been used together with local materials and have increased their role in vernacular villages, especially after the establishment of the protected forest area system in 1962 (Chettamat 1985). Among industrial materials typically being used in vernacular Thai houses are reinforced and mass concrete, concrete block, corrugated iron, fibre-cement, glass, gypsum plaster, plywood, sheet metal, and steel.

The relationship between the use of materials and the appearance of a building is confirmed in a study by Strike (1988). Although his research explored the relationship of building in Western Europe during 1700-1970, it revealed how new materials and new methods of construction have led to a change in architectural design and, eventually, in the attitude of designers and the features of design theories.

A building tradition and system of construction is shaped by a number of factors among which the locally available materials have significant influence. Local builders of the past had corrected unsatisfactory aspects of materials and the construction process until a local style was established. The sudden introduction of imported or mass produced materials in a remote community make changes which are normally considered as a threat to the originality and significance of the building stock by some conservators. It is indeed generally assumed that buildings using only local materials are true vernacular buildings (Bowyer 1980).

While other scholars accept that the domestic vernacular in most cultures has depended on readily available or easily portable resources (Oliver 1997), they argue with those who consider that the use of locally available materials is a fundamental defining quality of vernacular architecture. This is because these traditions in western

countries are regarded as having ceased with the mid-19th-century development of the railroads and commercial shipping, which facilitated international and intercontinental movement of goods and ideas.

Moreover, these scholars also believe that the export of industrial sheet materials, including corrugated and galvanized iron and roofing felt, have both extended the life of many vernacular traditions and protected them at a relatively low cost. In some countries, the vernacular tradition has actually developed on the basis of industrial products (Lewis 1997).

In attempting to define "vernacular" (Rapoport 1990), traditional vernacular has few models and relatively few materials and techniques. In contrast, popular or contemporary high-style has many models and numerous materials. At this time, in the study areas, there are plenty of materials applied to vernacular houses including traditional Thai houses. Many patterns of new construction or extension of existing houses could be defined to be models of vernacular houses. But many patterns are considered to be contributing to the extinction of vernacular houses in Thailand. Both new materials and local materials are investigated with the relevant construction methods. The influences of these changes are then linked to Thai construction features and are evaluated for impact on conservation and sustainability.

2.3.2 Traditional methods of construction

Before the late 19th century, neighbors usually helped each other in various activities that required labor, such as planting and building a house. For example, to build a new house, the owners announced their intention to their neighbors as a means of acquiring help to build a house. As part of their religious education, the community will receive instruction on how to properly build house and temple to be robust and propitious according to traditional beliefs and expertise (Piromya 1995). The *traditional Thai house* can be assembled within one or two days on the site because it is composed of components which are prepared before construction (Jaijongrak 2002, 1996, 1975). There was no formal payment for helping and donating labor for someone's work in Thai vernacular society. This relationship in the village is called *Long Khak* in Thai (Nartsupha & Leardvichadha 1998). The archetype and its transformation will be explained in Chapter 4.

Figure 2.3.1 Roof trusses assembled on ground

The construction processes involve putting all the completed woodwork together (Figure 2.3.1-2.3.3). Jaijongrak (2002) explained the processes of construction of the house as follows:

1. The ground is leveled before placing the foundation posts and house posts;
2. The principal post is erected according to tradition;
3. The remaining posts are erected and the structure of the house is put in place;
4. The roof truss is assembled on the ground before being placed on the house structure;
5. The purlins are nailed to the roof truss before roofing;
6. The joists are laid and the planks placed over them;
7. The wall panels are attached and door and window frames are fixed;
8. The front verandah is added on to the house;
9. The kitchen is placed in the back of the bedroom unit; and
10. Staircases are fixed in the front and the back of the house.

Traditional beliefs were important to the house construction. According to Jaijongrak (2002), there are many prohibitions related to house construction. Monks and local astrologers were the specialists in construction rules. The main principles of construction cover various aspects such as choosing an auspicious location, materials and times. However, the crucial rules, which are related to the house elements, are the ceremonies of digging the first hole for the first post, splitting of the gable top, and raising the house posts.

Figure 2.3.2 A roof truss placed on columns

Figure 2.3.3 Wall panels attached at columns

2.4 Categorization of nontraditional materials

The aim of this section is to clarify the categorization of materials, distinguished by historical periods and developments in Thailand. The periods and developments are mainly based on the previous study by Horayangkura (2001). The data for year, national influence and new impact in Table 2.4.1 are developed from his architectural development diagram.

As shown in Table 2.4.1, the first Thai capital was set up in Sukhothai in 1238. It was around this time that this kingdom was called *"Siam"*. The Sukhothai kingdom lasted for more than a century before it was absorbed in 1350 by the kingdom of Ayutthaya. This empire was built up over 417 years. During this period, foreign immigrants, mainly from China, nearby countries and later from other regions, mainly from Europe, started to arrive. The European influences appeared mainly in the later period after the establishment of Bangkok in 1782.

During the Sukhothai and Ayutthaya periods, the vernacular house was typically a hut made from bamboo and timber planks which is considered to be the prototype of the *traditional Thai house* (Puvanan 1999). In the early Ratanakosin era (1782-1851), there were both bamboo houses and timber houses, which were evolved from the earlier prototype. These houses were made completely from timber except

Table 2.4.1 Period and development of materials

	Sukhothai	**Ayutthaya**	**Bangkok** (Divided by period of Kings or government policies)			
			Early	**Colonialism**	**Transition**	**Current**
Year (AD)	1238-1349	1350-1767	1782-1851	1851-1925	1925-1983	1983-2007
National Influences	India	China, Khmer	Europe	Europe	U.S.A.	International
Impacts	-	-	Westernization	Westernization	Modernization/ Beginning of Thai Industries	Globalization
House Style	Tradition	Tradition	Tradition	Tradition/ Colonial	Modern/ Imported style	Post modern/ Imported style
Materials	Local	Local	Local	Local/Imported	Early industrial/Imported	Industrial

Note: 1. The data of y*ear, influence and impact* are derived from Horayangkura's diagram in 2001

2. The period of developments is taken from the sub-district bureau of Thai government in 2005.

for the roof cladding. Importantly, they have been regarded as the *traditional Thai house*, the most enduring icon of Thai style and design (Jotisalikorn 2001).

In 1932, a new generation of technocrats who supported democratic reform led to a change in government from absolute to constitutional monarchy. The name of the country, *Siam*, was changed to *Thailand* in 1939. Following this reform, most architectural design followed the modern movement of western architecture.

In the past, timber was used as the main building material. Brick and cement were used only in the construction of royal residences, palaces, and temples. In time, cement for concrete work became cheap and common places following establishments of cement production in 1913. Following this, the first plywood production was begun in 1951. Although the first *Industrial Promotion Act* was promulgated in 1954, modern Thai industries effectively started in the early 1960s.

Modernism, an important architectural movement, began to be popular in Thailand. During the 1950s to the 1970s, modern buildings with international standards were constructed for both the government and private sectors. In this period, new materials and modern building technology were tried out around the country, most extensively in areas close to major transportation routes.

With the introduction of industrial materials, the bungalow was one of the first common house-type to break Thai boundaries and become part of an international culture. In the 1960s, the housing projects around the Thai capital, Bangkok, were designed by the architects who graduated from the Thai universities with the western educational systems (Horayangkura 2001). The houses were usually constructed with the style of the American bungalow house. This style widely spread and was accepted from the residents in rural villages. However, this style was revised and constructed by the local builders.

According to Pinijvarasin (2004), the bungalow house, which is the product of modernism, was the subject of increasing attention in the Thai village during the 1960s to 1970s (Figure 2.4.1). The bungalow was not just a symbol of modernity; it was also cheap and practical. The Thai bungalow was not totally prefabricated like the American equivalent but partially based on on-site construction as the labor cost was very low (Puwanan 1999). Since the 1960s, the bungalow style has been used as a template for local development.

Figure 2.4.1 A bungalow-style house in the studied area

Thailand had become increasingly dependent on economic and military assistance after the Vietnam War period (Horayangkura 2001). Since the end of the 1970s, the policy of the Thai government was to increase self-reliance and stimulate economic development and the building industry. Significant improvements were made in the building materials industry. After that, commercialism has become a major influential factor in importing the various western styles found in European and American communities since the 1980s. Thongsakul (2001) stated that these

influences have been limited to the urban housing projects during the 1980s but recently expanded to the houses in rural areas.

2.4.1 Industrial materials

Industrial materials are produced from the use of mechanization and the process of mass production. Rowe (1993) stated that "*Instead of relying on individual workers to produce unique products, mechanical production processes were geared to produce identical component parts that were then assembled into specific products"*. Oliver (1997) wrote in his encyclopedia that industrial materials provide the basis for the emergence of new vernacular forms in industrialized societies of the 'fourth world' peoples in America or Asia. Lewis (1997) noted that the vernacular building in Australia has developed from industrial products. Therefore, the late 20th-century vernacular buildings usually depend on industrial materials. In many earthquake areas, an entirely new vernacular building built from reinforced concrete has been developed.

The employment of industrial materials increases after the availability of traditional resources diminishes. Oliver also stated that squatter settlements have begun to reuse industrial materials which were discarded for their survival. He grouped the industrial, re-used, and waste materials in the same category. The typical examples of industrial materials used with vernacular buildings found in Oliver's encyclopedia are mass concrete, reinforced concrete, concrete block, sheet metal, corrugated iron, fiber-cement, glass, gypsum plaster, plastic sheeting and plywood.

The spread of industrialization and trade of industrial materials has caused a significant change to vernacular houses. In some cases, industrial materials have been slightly added to improve the performance and change the appearance of buildings. However, some traditional buildings have disappeared after the introduction of industrial materials. Spence gave two examples of vernacular houses which have tremendous impact from the new materials. First, houses in northern Pakistan have been developed in order to facilitate use of galvanized steel sheets as standard materials. Second, houses in Ladakh have been transformed by the use of sheet glass to provide 'sun rooms' for winter warmth.

The change of use of materials may occur from the needs of improving performance. Reinforced concrete has directly related to the change of traditional buildings in many disaster areas. In southern Thailand, there have been many major

natural disasters (*EM-DAT: the OFDA/CRED International Disaster Database*, 2003). The study areas in middle Thailand are affected by seasonal floods and have had disasters from floods (*Center for Hazards & Risk Research at Columbia University*, 2007). From interviews in 2005, residents mentioned that there was a great fire in Ladchado village in 1938, in which almost a hundred traditional houses caught fire. After that, the residents reconstructed their houses in a modified form with bungalow style and non-flammable roofing materials.

Jaijongrak (2000) stated that the change of materials in central Thailand is mainly caused from diminishing supply of traditional materials. Introduced in 1932, the *Forest Reserve Act* initially protected some areas of the preserved forest. After that, the protected area has been enhanced and affected the availability of timber. However, the forest has still declined rapidly. According to the publication by the *Thai Royal Forest Department* (1998), the forest area was more than 60 percent of the country area in 1950 and dropped to 29.4 percent in 1988. Since 1989, all timber industries have been banned and the price of timber has increased dramatically (Puwanan 1998). Although timber was still available from domestic stocks, the price was rising after the ban and became very expensive in the late 20th century. Teak sawn price in 1995 was 230% more expensive than in 1985 and 725% more expensive than in 1975 (Table 2.4.2). These increasing prices can be related to the growth rates of Thai economy of about 9% annually from 1970s to 1990s (Bureau of Trade and Economic Indices of Thailand 2007).

Currently, quality timber is nearly out of stock in the country and has to be imported from Myanmar and Cambodia. The price of the imported timber is not shown in the Thai construction journals because of the limits and inconsistency of the suppliers. However, low-grade timber is still used with used materials in the low-cost or rural houses at the present (Denpaiboon 2001).

Pinijvarasin (2006; 2004) noted that the changes of the Thai vernacular houses have been accelerated during the last three decades and evolved from the need of well-being in modernized conditions. Vellinga (2006) gave clarification that the development of new vernacular houses related to local status and prestige, and they served as symbols of wealth. The combination of tradition style and new materials expressed the superior status of the residents.

Table 2.4.2 Price of main construction materials in 1975, 1985, 1995 and 2007

Materials (metres)	**Unit**	**Price (Baht / Increasing rate in 10 years)**			
		1975	**1985**	**1995**	**2007**
Teak (0.025 x 0.15 x 1.80)	Square meters	7200	18,000 (150%)	59,400 (230%)	-
Cement	Tons	440	1,233 (180%)	1,590 (29%)	1,970 (24%)
Cement roof tiles (Corrugated, 0.50 x 1.20)	Tiles	8.50	33 (288%)	40 (21%)	48 (20%)
Round bar steel (9 mm., SR.24, 3.00 metres long)	Tons	4,350	8,570 (97%)	13,790 (60%)	22,287 (61.5%)

Source: *Contractor's Times* Journals (1975, 1985, 1995 and 2007)

Note: First journal was published in 1973.
The prices in these journals are taken from the *Bureau of Trade and Economic Indices of Thailand*.

Thus, the increasing use of industrial materials in the study areas has mainly occurred from the diminishing of timber, the need of better performance materials, modernized conditions and the desire of expressing status.

2.4.2 Early industry and contemporary

In the present study, construction materials and methods of Thai vernacular houses are classified by period and development into three categories: traditional, early industry, and contemporary. The traditional was previously described in Section 2.3. The early industry and contemporary are described below.

Early industry

In this study, early industry is termed by the materials and methods of construction used in the vernacular Thai villages from the 1920s to the 1970s (Table 2.4.1). Horayangkura (2001), who defined this period, stated that the first steel bridge in Thailand manifested a new era of technological advancement in 1932. Puvanan (1999) concurred that this period was the beginning of the uses of new materials, new forms of construction elements and many construction material factories.

When the modern style and industrial materials began to be common to the urban housing in this period, the traditional Thai house was initially adapted to modern construction and industrial materials. In the study areas, early industrial materials, which are found from surveys and interviews in 2005, includes corrugated metal sheets, corrugated fibre-cement tiles, fibre-cement boards, gypsum-plaster boards, pre-cast and cast-in-place concrete (locally built) and plywood. The data of materials in the study areas will be discussed in Chapter 5 and 6.

Contemporary

This category is defined by the modern industrial materials and methods used in vernacular Thai villages since the early of the 1980s to the present (Table 2.4.1). Horayangkura (2001) and Puvanan (1999) similarly placed the latest development in this period because of the rapid development growth. Thailand had been recognized as one of the *Newly Industrialized Countries* at the end of the 1980s. Puvanan (1999) mentioned that Thai consumers in urban housing projects always prefer imported materials, technologies and styles.

Figure 2.4.2 A house with typical modern style and reinforced concrete structure in Central Thailand

The materials and methods in this category are currently used by contractors and real estate developers. They are common in the suburban housing projects but have begun to be used in rural areas. The contemporary materials include pre-cast and cast-in-situ concrete (professionally built), glass, concrete block, concrete roof-tiles and terracotta floor-tiles. Steel is used for the roof structure, ceiling studs and wall

studs. Aluminum is common for covering extended garages or additional shading. The example of a house constructed with the style of suburban housing projects is shown in Figures 2.4.2.

2.5 Thai construction features

There were various descriptions about the features of a *traditional Thai house*. Jotisalikorn (2002) highlighted transportability to be the key feature of the Thai house. This is manifested with the use of word '*prung*' in Thai language for house building, which literally means assemble. A *traditional Thai* house could be quickly dismantled, and moved to assemble at a new site. This has been a common occurrence for building a new house.

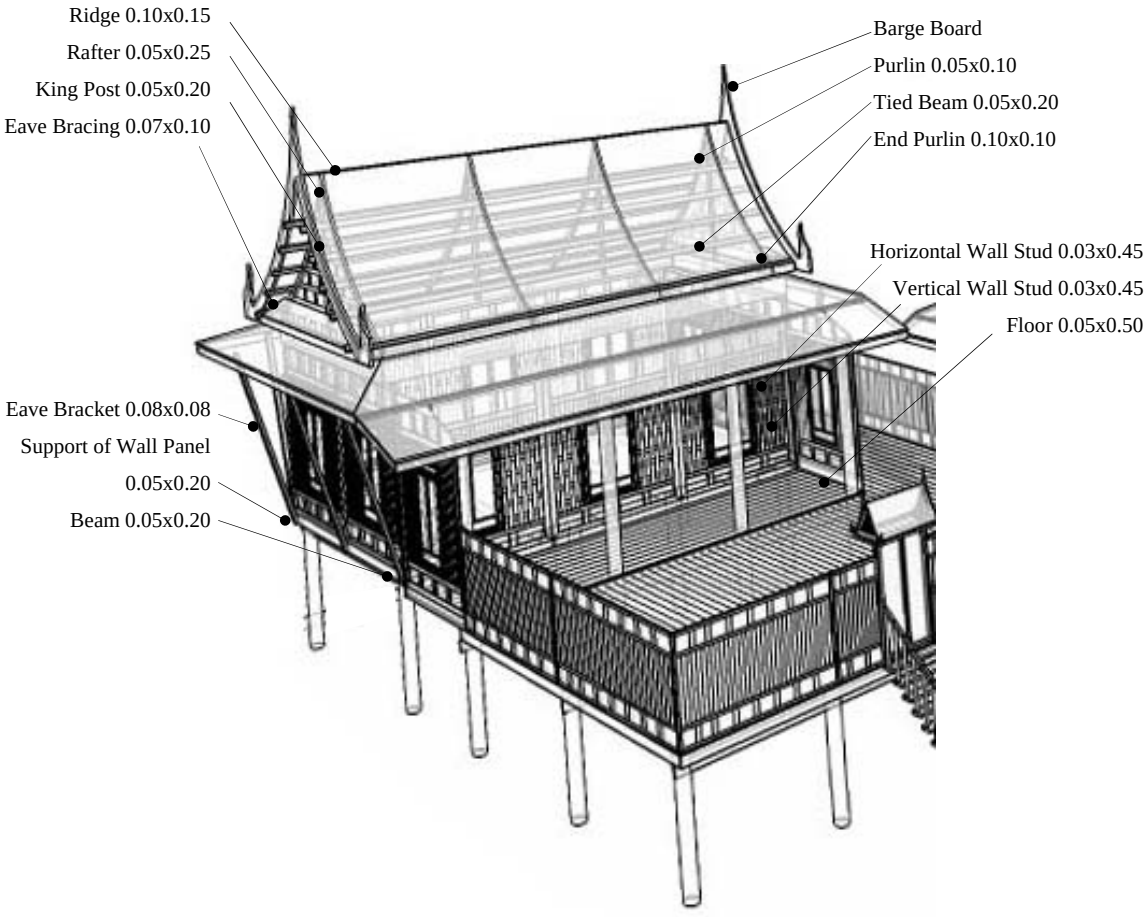


Figure 2.5.1 Feature of the *traditional Thai house*

Piromya (2002) proposed twelve features of the *traditional Thai house*: prefabrication, structural frame, house size, roof materials, house plan, shape, partitions, floor, staircase, bonding and craftsmanship. However, only five features of prefabrication, structural frame, house size, bonding and craftsmanship could be categorized to be construction features. All those features have made a distinctive quality of construction in the *traditional Thai house*.

Traditional Thai houses are built around a fundamental skeleton structure or a load-bearing frame structure and cladding. Frames are made of timber, whilst cladding is made of timber planks or split and woven bamboo. The main components of the frame are posts, beams, wall studs, kingposts, rafters and purlins (Figures 2.5.1). Four-fifths of the house components are prefabricated on site (Roonrakwit 1997). The prefabricated elements in a *traditional Thai houses*, in turn, has helped to less use of building materials, especially when comparing to the construction of western houses (Nimmanahaeminda 1969).

In addition, almost every procedure and component of construction of *traditional* Thai houses has customarily associated symbols and beliefs. Builders have to determine the right time or auspicious time, date and month when placing the first pile. They also have to consider the direction that the house is going to face. The number of components such as the number of steps and columns is also dependent on traditional belief of a particular locality. The width and length of the house are measured so as to relate to a specific number that was considered to be auspicious and suitable exclusively for a particular family.

Figure 2.5.2 High-pitched gable roofs

The traditional Thai measurement system of scales and dimensions is usually related to human dimension. In house construction, this includes such as “wah” (2 meters), “sok” (50 centimeters), “khueb” (25 centimeters) and “new” (2.54 centimeters or 1 inch). The quantities of boards are calculated in “yok” (around 17.79 square foot). The size of the house depends on the function of the building but always follows the archetype of architecture of the locality. The width of a main building is 3, 3.5 and 4 meters. The length of a main house is usually appeared with odd numbers of column spans, such as 3, 5 or 7. However, most main houses are traditionally found in 3 spans or 3 rooms. The height from floor to tied beam is 3.5 meters. The height of the underneath space is 2 to 2.5 meters (Piromya 2002).

Figure 2.5.3 Multi-purpose space underneath a raised floor

The height of a gable roof is four-fifths of the width (Figure 2.5.2). The shape is a rectangular one-storey house with a raised floor and space underneath (Figure 2.5.3). The gable roof covers the veranda on one side. The house columns and walls lean inward in all four directions. All building elements are wooden, and their connection is made with mortise and tenon joints to join the frames without using nails or screws. However, in the last few decades, steel bolts and nails are more commonly accepted (Figures 2.5.4 and 2.5.5).

Figure 2.5.4 Mortise and tenon joint with addition of nails at the parts of wall panels

Figure 2.5.5 Steel bolts at connection of concrete columns and wooden beams

2.6 Previous studies on Thai vernacular houses

Studies on Thai vernacular houses have begun since the 1950s, and increased after the 1990s. Horayangkura (2001) compiled a list of academic studies on Thai architecture and categorized them into three main types: studies of regional houses; studies of temporary houses; and studies of the houses of specific ethnic groups.

In addition, Horayangkura revealed that most of the studies focus only on the traditional houses and do not relate to the contemporary vernacular houses. Only some studies are concerned about new or emerging vernacular houses, which have been transformed in the recent period. Therefore, the studies on Thai vernacular houses can be divided into two groups: traditional house and contemporary vernacular house.

2.6.1 Studies on traditional houses

This group mostly focused on the traditional houses, which are divided into four main regions of Thailand: Central region, Northern region, North-eastern region, and Southern region. However, there have been only a few literatures written on the temporary houses and the houses of specific ethnic groups. Interestingly, the traditional houses which have been studied are the models that typically appeared during the 18th century to the 19th century.

The early studies of the *traditional Thai house* in the central region were written by Anuman-Rajadhon in 1950. This, then, was followed by the studies of Piromya in 1974 and Jaijongrak in 1975, which later have established the interests of vernacular houses for many Thai scholars. Thus, more studies about the *traditional Thai house* were produced in the 1990s and 2000s (Jaijongrak in 2002, 1997, 1996; Silapanon in 1997; Kullayanamitt in 1996; Piromya in 2000; 1995; and Paknam in 1992).

Since the 1990s, many studies have been conducted on the traditional houses in the northern region, *Kalae house* (Panin in 2002; 1997; Charoenpakul in 1997; Jindawong in 1997; and Temiyabandha in 1997; 1995). In contrast, there have been not much study on traditional houses in the north-eastern region (Nilathi in 2002; Silpanon in 1997; Srisuro in 1995) and in southern region (Rattanajarana in 1995; Suwankiri in 1995).

Horayangkura (2001) stated that only the studies of the *traditional Thai house* in the central region show the measurement works and some systematic analyses of the physical appearance of the houses. Most of the studies in the other regions were conducted with unsystematic analyses and lacked architectural details.

These studies provide a valuable understanding of the traditional house in some attracted periods. However, they are limited by their own assumptions and definitions. Vernacular houses, considered to be the 'Thai authentic' traditional buildings, are only the houses in pre-modern times, and deserved to be studied. Most scholars tend to work on the same types of traditional houses and had similar focuses and results.

2.6.2 Studies on contemporary vernacular houses

Before the twenty-first century, there were only a few studies concerned about the contemporary vernacular houses. In the 1990s, only the studies by Temiyabandha

(1995; 1994) reported about the changes of the traditional houses, or called *Kalae house*, in northern region. He stated that the contemporary *Kalae houses* usually retain the features of the floor plan but their building enclosures have commonly changed with the use of new materials and technique of. His studies, however, were described without systematic analysis.

There have been increasing numbers of studies on the contemporary vernacular houses after the twenty-first century. Two researches for the degree of Doctor of Philosophy began the new approaches of the study on Thai vernacular houses. These research projects accepted the contemporary vernacular house, which were changed over time.

First, Pinijvarasin (2004) studied about Thai vernacular house in the central region. The study confirmed that vernacular houses have always changed in accordance with the change of the villagers' experience of well-being. Second, Thungsakul (2001) studied about the vernacular living space in the north-eastern region. The study indicated a continuous alteration of spatial pattern of the house in accordance with the change of lifestyle.

In addition, few studies regarding changes in vernacular houses were conducted for the master degree in Thai universities. Pengchad (2002) studied the settlement of hill tribe in northern region and concluded that the style of dwelling has altered according to social and economic changes. Wongkham (2001) explored the development of the vernacular house in north-eastern region and concluded that the house style has changed while the spatial pattern of planning of the house has remained unchanged.

These research projects began the new direction of the study on Thai vernacular buildings. These studies has expanded scope of understanding and raised awareness in the contemporary vernacular building. It coordinates to the movements of the practice of vernacular study in the twenty-first century (Vellinga 2006). However, there are still many unexplored fields of research at an international and inter-disciplinary level.

2.6.3 Unexplored research topics

According to Vellinga (2006), studies that pay attention to recent and modern vernacular buildings are relatively rare. Despite these new vernacular buildings, which are not always as exotic or distinctive as the traditional buildings, are the

majority of buildings in the concern of society, they are still in less attention among academic and professional. Vellinga also noticed that all buildings, whether traditional, modern or modernized hybrid, could be regarded as vernacular because of their distinctive cultural expressions. Merging of old and new features of the contemporary vernacular buildings still needs to be studies.

Pinijvarasin (2004) stated that there has been insufficient consideration of changes to Thai vernacular houses in respond to changing socio-cultural conditions resulting from modern development. However, because her research was in a single locality, she suggested a cross-cultural, comparative study. This type of study has highlighted similarities and differences among various cultures, regions and societies. This has suggested two interrelated topics for further study: 1) study of local significance that has to be re-invented; 2) study of applications of cultural and global knowledge.

Similar to the suggestions from Pinijvarasin, a comparative study was advised as the potential areas of future research by Thongsakul (2001). The other potential topics were environmental behavior, meaning and value, and change of materials and construction technologies.

Horayangkura (2001) stated that there are three approaches of the studies on Thai vernacular houses: contextual; interpretation; and evolution.

There have been many fields of research in contextual group but mostly concentrated in physical features, and relationship between the houses and the people activities and beliefs. In this group, there have been increasing numbers of research projects on climatic responsive design. In this contextual group of study, Temiyabandha (1995; 1994) commented that research regarding technological, material and structural factors in vernacular buildings still have been limited.

The interpretation group has been increasingly conducted and has provided a better understanding of principles, descriptions and meaning of the houses. Significantly, the evolution group, began in the 1990s, has continued to the twenty-first century by a few scholars. Although there are courses of vernacular study in some Thai universities, this group still shows a lack of studying in international and inter-disciplinary level.

In conclusion, there have been a few scholars who focus on the contemporary vernacular houses. Importantly, the study about technological, material and structural factors has been rare on the traditional houses and has not been found on the

contemporary vernacular house. Also, a comparative study of those vernacular buildings in various locations will suggest for better understanding of similarities and differences among them.

2.7 Conclusions

Vernacular buildings were built by the local people for the uses in their everyday life, and handed down from generation to generation. They are in various types for various purposes. However, most of them are for dwelling, and they always change in according to the changing conditions of socio-culture and environment of the locality.

Studies on vernacular houses have been in both conservative and sustainable approaches. However, the research concerning about the adaptation of vernacular buildings has suggested clues that could ensure the sustainability of those houses. Thus, there is the possibility for exploring contemporary vernacular building.

The influences of materials upon vernacular building seem to be significant to the construction features. The adoption of modern materials is regarded as one of the most important factors in the change of traditional houses. New materials have resulted to changing methods of construction, and thus the appearance of the house. Studies of Thai vernacular houses have been in various approaches. However, there are only a few public literatures about materials and construction in Thai contemporary vernacular houses. Thus, a study on contemporary vernacular buildings in Thailand concerning their materials and constructions is still needed. Moreover, there are three distinct periods of architectural movement: tradition, early industry and contemporary. These can be applied to categorize both materials and methods of construction for this study.

Chapter 3
Research Design

3.1 Introduction

This thesis aims to understand the changes of features of the house, construction elements, use of materials, and construction methods of the contemporary vernacular houses. Defining research methods to study on these aspects are needed. Thus, this chapter begins to explain about the selections of location and case study in Section 3.2. This is, then, followed by clarification of the methods for data collection in Section 3.3, composing of sampling procedures and pilot study, data gathering, related documentation, , and survey forms. The methods for analysis are explained in Section 3.4, and, finally conclusions are in Section 3.5.

3.2 Selections of study locations

For this research, it is necessary to select areas that still have active housing development and a large number of traditional houses. Houses in the selected areas also have to show various patterns of their transformation and changes of construction elements. This helps to provide an understanding of changes in using materials from traditional to contemporary of those houses. Thus, to obtain enough representative samples, the selected study locations have to be drawn from several locations with different levels of influences associating with the changes.

Two main approaches in selecting study locations could be: 1) locations selected from various regions across Thailand; and 2) locations selected from various localities within one region. Research locations from various regions or localities also provide more opportunities for comparative perspective than from one area. According to Panin (1999), Thai vernacular houses in different regions or localities are always different in the details of physical appearance, living activities and beliefs of the residents. Rapoport (1981) stated that a comparative study from various locations could show contrasts or clarify similarities among them.

However, the studies of Thai vernacular houses from various localities in one region are not only appropriate to compare differences, but also provide an opportunity to control other unrelated factors, especially the different conditions of

culture and social life of the localities. The selection criteria of the region and the localities are concluded, and their information is described in Sub-sections 3.2.1 and 3.2.2.

3.2.1 Selection of a district and a locality

Criteria for selecting an appropriate district and locality for this study are as follows:

1. The district offers various types of localities that have been developed from different influences. Transportation routes and distance from a town or a city centre are included.
2. The district and localities have an adequate number of vernacular houses and shows various types of vernacular houses.
3. Each locality contains a consistent house sample, which relates to the *traditional Thai house*. The houses may have been transformed from the *traditional Thai houses* or drawn from the traditional Thai style in development of new houses.
4. The district should be in the vicinity of Bangkok due to the availability of the survey team for this research in gaining access to the study areas and also a limitation of research budget.
5. Supporting data are accessible and available.

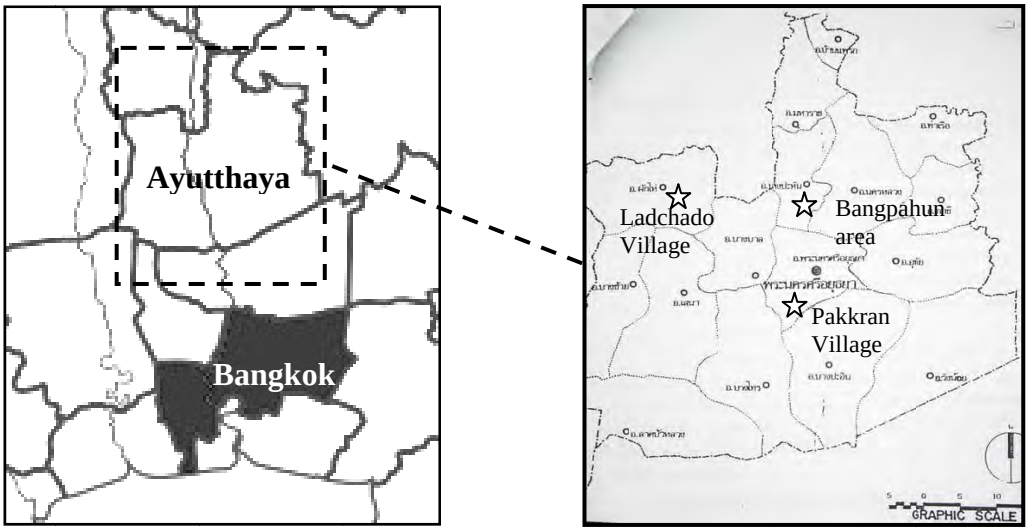
After comparison with other potential provinces, Ayutthaya was selected as the region of study because it meets all criteria. Ayutthaya was the previous capital of Thailand from 1350 to 1767. The centre of Ayutthaya is one of Thailand's most valuable cultural heritage areas, and part of the city centre was declared as a UNESCO *World Heritage Site* on 13 October 1991. In addition, Ayutthaya is well known as a significant location of *traditional Thai house*, which is considered by scholars to be the representative of a Thai house (Jotisalikorn 2002).

However, Ayutthaya has been substantially impacted from the growth of the current capital, Bangkok, during the past forty years. With a 75 kilometer distance from the capital, a cross-region motorway, the influences of urbanization and modernization have increased changes to the localities of the province (Figure 3.2.1). Ayutthaya is presently both an ancient city and a modern city with around 727,000 people. The province occupies an area of 2,547 square kilometres and is located north

of Bangkok (Figure 3.2.2). A shift from agriculture to industrial and service sectors became apparent during the 1980s (Chulalongkorn University 1980).

Ayutthaya has been studied in various aspects. Many of these studies aimed to conserve all those heritages of the province. One of significant study was a master plan for conservation and development, released in 1999 (Silpakorn 2000). This study was to make conservation plans for the archaeological sites and heritage of Ayutthaya. It was composed of various issues: history and archaeology, vernacular architecture, landscape, sociology, economics, and tourism. Part of this project concluded that Ayutthaya is one of the provinces with finest vernacular dwellings and environments in Thailand, but they have been diminishing in quantity and radically changing without sufficient guidelines. However, many of them still remain. Some, found in large quantities, are the typical *transforming Thai houses*. The typical *reproduction Thai houses* have also been developed. Therefore, Ayutthaya is able to show sufficient evidence of the evolution of Thai vernacular houses.

Figure 3.2.1 Map of Thailand and site of Ayutthaya province
(Source of map A: Adapted by the author from http://th.m.wikipedia.org)



A) B)

Figure 3.2.2 The locations of Ladchado village, Pakkran village, and Bangpahun area (Source of map A: Adapted by the author from http://th.m.wikipedia.org and map B: Adapted by the author from Silpakorn University 1999)

3.2.2 Three study locations

The preliminary surveys for the potential localities for this research were suggested by some researchers, who have conducted some research projects of vernacular houses in Ayutthaya (Panin 1999; Pinijvarasin 2004). The localities within Ayutthaya was chosen to fulfill three requirements: 1) different rates of changing local conditions due to location and transport networks; 2) impacts of modern development, receiving the pressure from Ayutthaya's city centre and Bangkok; and 3) influence possibly exerted by the presence and policy for the *World Heritage Site*.

After surveys of potential localities, three selected areas are Pakkran village, Ladchado village, and Bangpahun areas (Figure 3.2.3 and Table 3.2.1). These study areas are located in different districts of Ayutthaya. Pakkran village is located in Ayutthaya district (urban district vlllage). Ladchado village is located in Phak Hhai district (rural village), while Bangpahun area is situated in Bangpahun district (buffer area). Pakkran and Ladchado villages have a good variety and quantity of vernacular houses that are in transformation, while Bangpahun areas consist of reproduction houses. Especially in Bangpahun, most reproduction houses are newly built and resembled the appearance of the *traditional Thai houses* (Figure 3.2.4). The data on the vernacular houses in the selected locations were acquired from the local government offices and public health centre during the survey period in 2005.

Table 3.2.1 Period and development in the three study locations

	Sukhothai	**Ayutthaya**	**Bangkok (Ratanakosin)** (Divided by period of Kings and policies)			
			Early	**Colonialism**	**Transition**	**Current**
Year (AD)	1238-1349	1350-1767	1782-1851	1851-1925	1925-1983	1983-2007
National Influence	India	China, Khmer	Europe	Europe	U.S.A.	International
Architectural Impact	-	-	Westernization	Westernization	Modernization/ Beginning of Thai Industries	Post-modernism/ Globalization/ Localization
House Style	Sukhothai Tradition	Ayutthaya Tradition	Thai (Siamese) Tradition	Thai Tradition/ Colonial Architecture	Modernism	Sustainable Architecture/ Architectural Identity
Materials	Tradition	Tradition	Tradition	Tradition	Early Industry	Contemporary
Pakkran Village (Urban district)						
Develop-ment				Beginning of village (1900s)	Road (1974)	
Ladchado Village (Rural area)						
Develop-ment			Beginning of village (1700s)		Walkway bridge (1975)	Road (1985, 2004, 2005)
Bangpahun Area (Buffer area)						
Develop-ment				Beginning of Village	Beginning of development along the new motorway (1970s)	

Note: 1. The data of *Year, influence and impact* are derived from Horayangkura's diagram in 2001

2. The period of developments is taken from the sub-district bureau of Thai government in 2005.

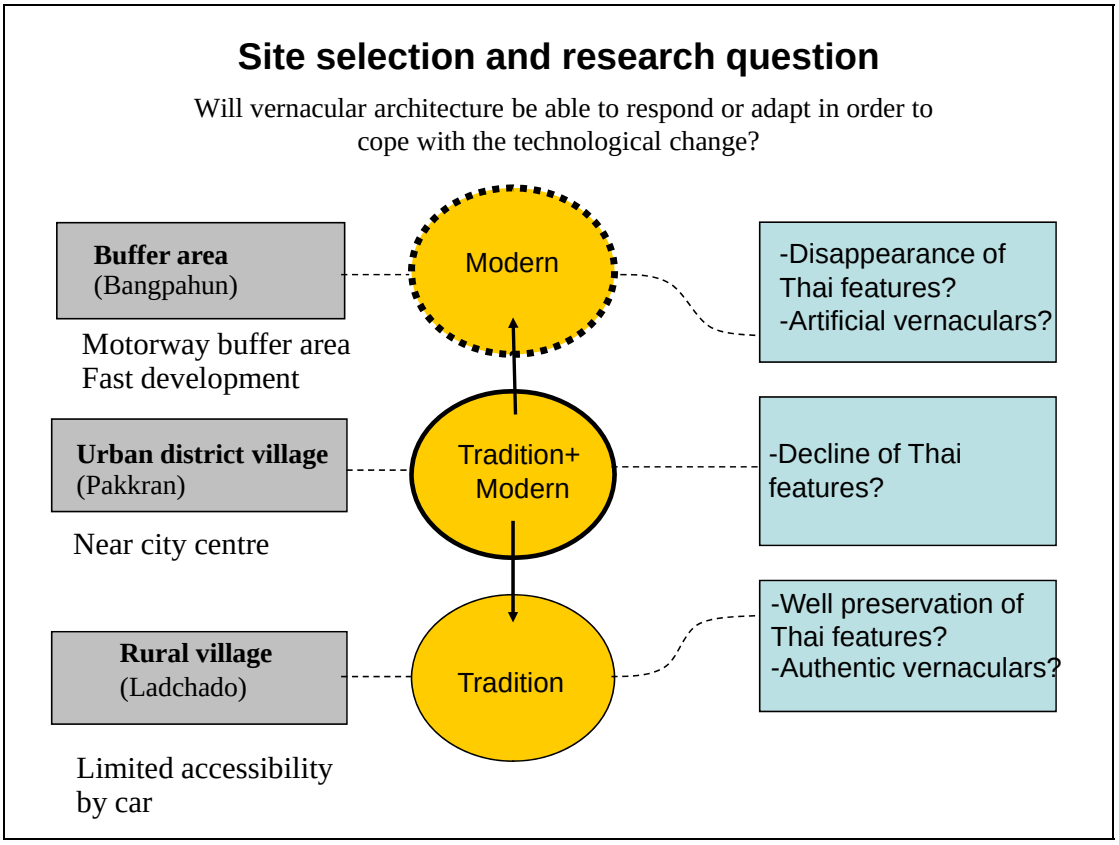
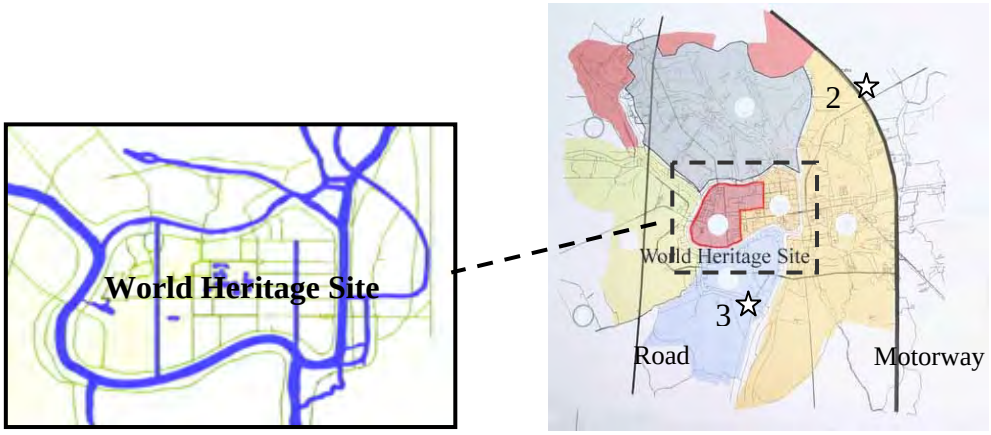


Figure 3.2.3 Diagram of site selection and research question



A) B)

Figure 3.2.4 The locations of Banpahun area (2) and Pakkran village (3) close to the *World Heritage Site* (Source of map A: Adapted by the author from http://www.thailandsworld.com and map B: Adapted by the author from Silpakorn University 1999)

3.2.2.1 Pakkran village (urban district village)

Pakkran village[1] is a sub-district of Pra Nakorn Sri Ayutthaya district. It is located in the central area, which is 7 kilometres south from the city centre of Ayutthaya (Figure 3.2.5). It was evident that people have lived around this area before the 1400s, but this sub-district was formally established in the 1850s. There are two main canals in Pakkran: Ta Kean and Pakkran. Takean canal is major route of the community, connected with Chaophraya river, Pakkran canal is a sub-route of Takean canal. Most of houses were built along these two canals.

This Urban district village is conveniently linked to nearby districts due to the development of roads around the village. People can gain access to the city centre in only fifteen minutes by motorcycles or cars. Public transport trucks consume more times but still take less than 45 minutes. Pakkran village is composed of 14 sub-villages. The population is about 5,500 and around 47 percent of its population work in agriculture-based industry, while the rest work as employees in nearby factories and other occupations such as government service.

From Figure 3.2.6, settlements along Takean and Pakkran canals had remained unchanged between the 1850s to the 1970s. Rice fields and forest areas were a common landscape of this village in the past. However, the first road was constructed and cut through the forest areas of the village in 1975. This road, which is in parallel to Takean canal, has helped to connect the village with the city centre of Ayutthaya, and the motorways. Thus, it has made the villages more easily accessible, particularly by cars. The additional local roads along Pakkran canal were constructed in the 1990s.

After the development of roads of the village, most houses along the watercourses were relocated to the land near the road. These houses were also adjusted and faced toward the road instead of the canals. Also, the new houses were built toward the roads. Subsequently, Pakkran canal became narrow and shallow because of lack of use. In late 1990s, flooding began to disappear from the village.

In the new conservation master plan, Pakkran village was selected to be included in the expanded conservation area of Ayutthaya (Silpakorn University 1999).

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1 This research will call Pakkran village as “Urban district village” in order to identify the conditions of development around this area.

Surveyed by local government staff in 2005, there are about 1,100 houses in Pakkran village and half of these houses have been transformed from the *traditional Thai house*.[2] The others are bungalow-style houses and contemporary houses.

3.2.2.2 Ladchado village (rural village)

Ladchado village[3] is located about 40 kilometres northwest of the city centre of Ayutthaya. The village, surrounded by agricultural fields and usually flooded, has been established since the 1760s. The village is divided by watercourses into two sub-districts and is currently defined as a main area of Pakhai district. Compared with the other two study locations, Ladchado is the most far from the city centre of Ayutthaya, as well as its transportation network, which has made the difficulty to gain access to the village (Figures 3.2.7). Ladchado village currently contains vernacular houses developed from the *traditional Thai houses* more than any other villages within Ayutthaya. It is initially assumed that this village has still maintained vernacular tradition as well as the living conditions.

The houses of this rural village are arranged in clusters, usually occupied by relatives. The clusters are linked by concrete or wooden bridges. These bridges have helped the residents with convenient living in time of floods. In the past, travelling by the watercourses was the major route of transportation of the village. In 1985, the first local road was constructed on the north part of the village (Figure 3.2.8). Although the new local road along the whole area of the village was additionally constructed and finished in 2004, most houses in the village are still inaccessible by car.

Surveyed by local government staff in 2005, there are 2,200 houses in the village and approximately 30 percent of these houses were evolved from the *traditional Thai house*s to the *transforming Thai houses*. Similar to Pakkran village, the *transforming Thai houses*, bungalow-style houses, and contemporary houses were found in the village.

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2 For this study, these house type will be called "*the transforming Thai house*" (see Chapter 2).

3 This research will call Ladchado village as "Rural village".

3.2.3.3 Bangpahun area (buffer area)

Bangpahun area[4], a buffer zone along the motorway, is chosen to compare the developments of contemporary vernacular houses, transformed from the *traditional Thai houses* withthe houses in the urban district village (Pakkran) and the rural village (Ladchado). The motorway, connecting Bangkok to northern regions, was constructed in 1970 and has been developed to become one of the main motorways in the country (Figures 3.2.9). Bangpahun area is located approximately 13 kilometres northeast from Ayutthaya city centre, and 72 kilometres north from Bangkok. Although Bangpahun district was formally established in 1897, people have lived in this area before the 1590s. Bangpahun district nowadays consists of 17 sub-districts. However, this research focuses on the vernacular houses in three sub-districts (Bangpahun, Poe Sam Ton, and Ban Li Tambons), which are settled along the buffer area of the motorways.

Several villages, which are close to this buffer zone, have plenty of *traditional Thai houses* before the 1970s. However, these villages are not in the scope of this study because many vernacular houses found in the villages are not transformed from the *traditional Thai house*. A large number of old *traditional Thai houses* were previously dismantled and replaced with new houses in non-traditional styles.

In the mid 1970s, many craftsmen who can build the *traditional Thai house* of the localities realized that the motorway has brought new customers from the other regions. Most of them lived in Huahad village, one of the villages in the motorway buffer area. After the motorway construction, they built the *traditional Thai house*, and sometimes relocated the old *traditional Thai houses* to show and sale on their land along the motorway. Later on, the othercraftsmen in Bangpahun district who did not own any land along the motorway rented or bought the land, and established their houses and workshops. During from the late 1970s to the 1980s, after Bangpahun area became well known as a place for buying the *traditional Thai house*, merchants from the other provinces brought the *traditional Thai houses* to sell in this area. Nowadays, there are eight workshops for building the houses in traditional Thai style along the motorway in Bangpahun area. Timber used in this area has usually been imported from Myanmar and Laos.

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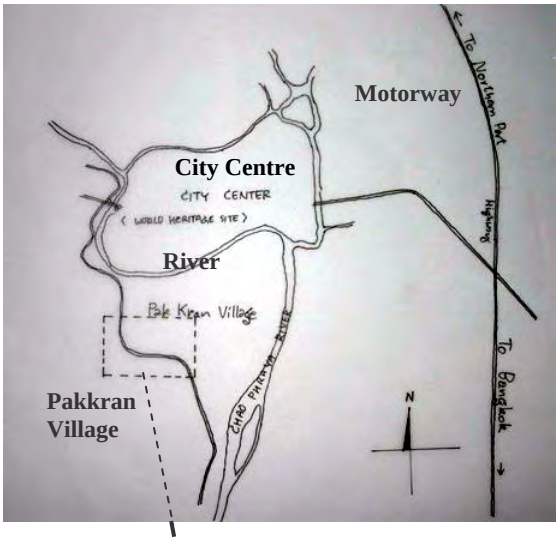
4 This research will call Bangpahun area as “Buffer area”.

In the 1990s, buildings with the reproduction of traditional style began when the builders combined the forms of the *traditional Thai house* with the contemporary house. The development of this vernacular house type has occurred from the increasing demands of new ways of using the house and availability of new materials. Foreigners and wealthy Thai are usually the customers to buy this resembled traditional style house, or "*the reproduction Thai house*" called in this research. However, most houses in the motorway buffer area belong to the local builders, who also built their workshops beside these houses.

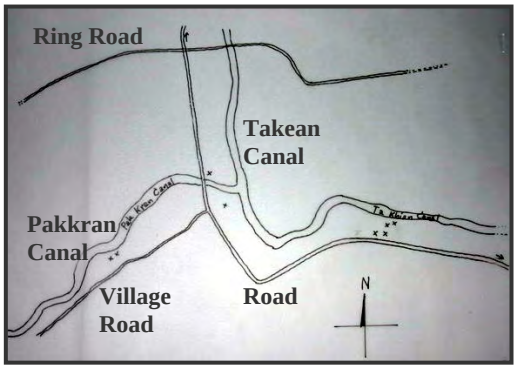
The builders in Bangpahun area have produced a large number of both *the traditional Thai houses* and the *reproduction Thai house*, which combines both traditional and contemporary styles. Estimated by eight builders in 2005, approximately 350 *reproduction Thai houses* have been produced in the motorway buffer zone in Bangpahun area, and sent to assemble in other districts or provinces since the 1990s. However, most customers usually ordered only traditional house parts. The contemporary house parts have normally been constructed by the other builders. However, there are about 30 *reproduction Thai houses* found in Bangpahun area.

3.3 Methods of data collection

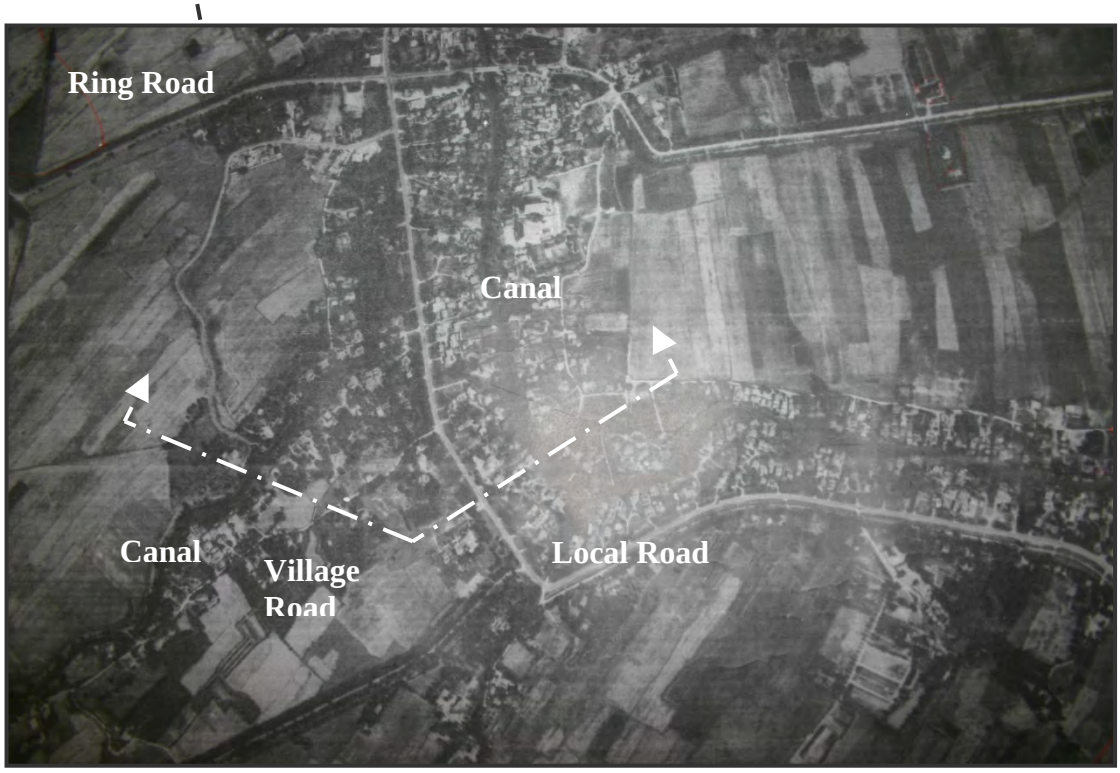
Because the uses of materials and physical features of the contemporary vernacular houses are key main data, most of them were obtained from field research, conducted intensively in 2005 and occasionally in 2008. There were several techniques used to obtain data concerning basic information about transformations and construction elements. This section illustrates the field work methods for gaining and gathering data. It also includes descriptions of documentary study and testing of the survey form, which are mainly used for collecting data during the field surveys.



(a)



(b)



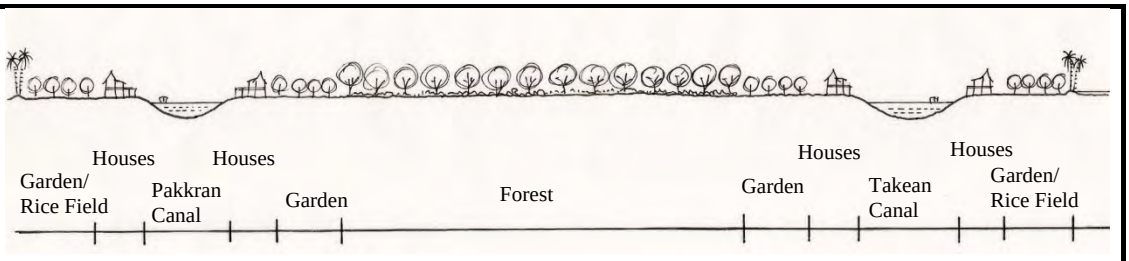
(c)

Figure 3.2.5 Pakkran village in 2005

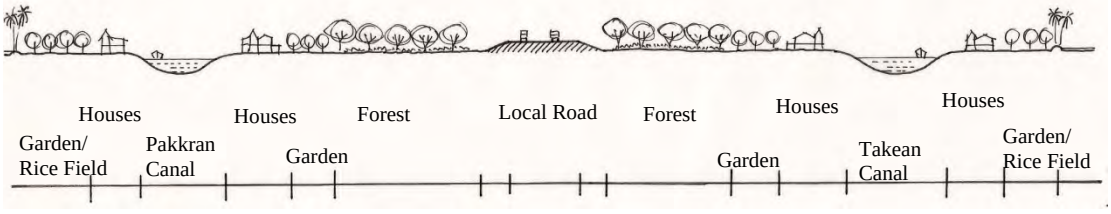
(a) Location of the village and the city centre

(b) Canals and roads in the village

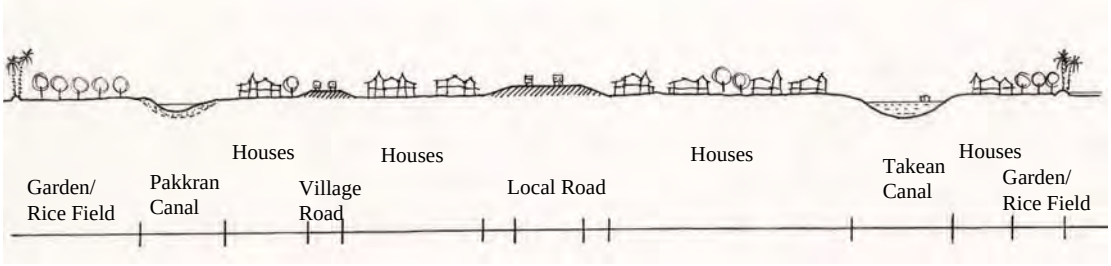
(c) Aerial photograph of the village Source: Adapted by the author from *Division of Aerial Map Collection* of Thai Army, 2005



Year: 1950s
Appearances of the settlement:
- Linear settlement along the canals

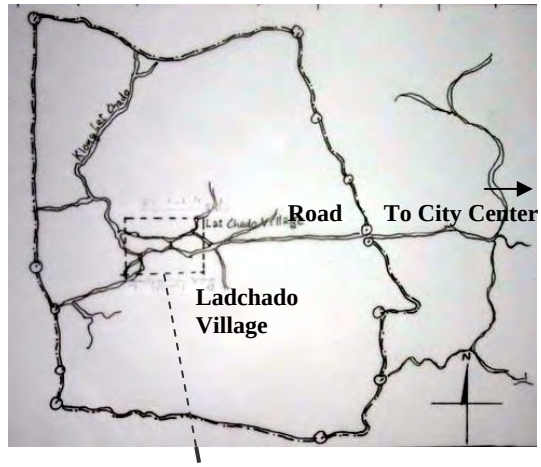


Year: 1975
Changes of the settlement:
- Beginning of the local road along the main canal
- No flooding in some areas since the construction of the local road

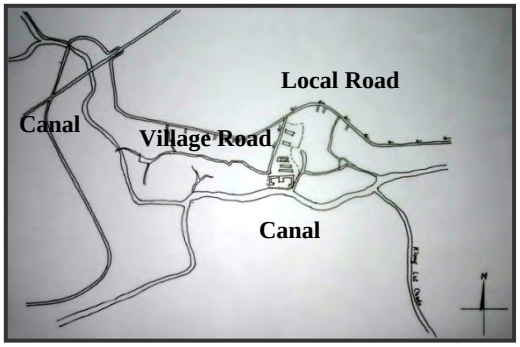


Year: 2005
Changes of the settlement:
- Road inside the village
- Pakkran canal became narrower and unused.
- No flooding in the whole area since the construction of the village road in 1990s

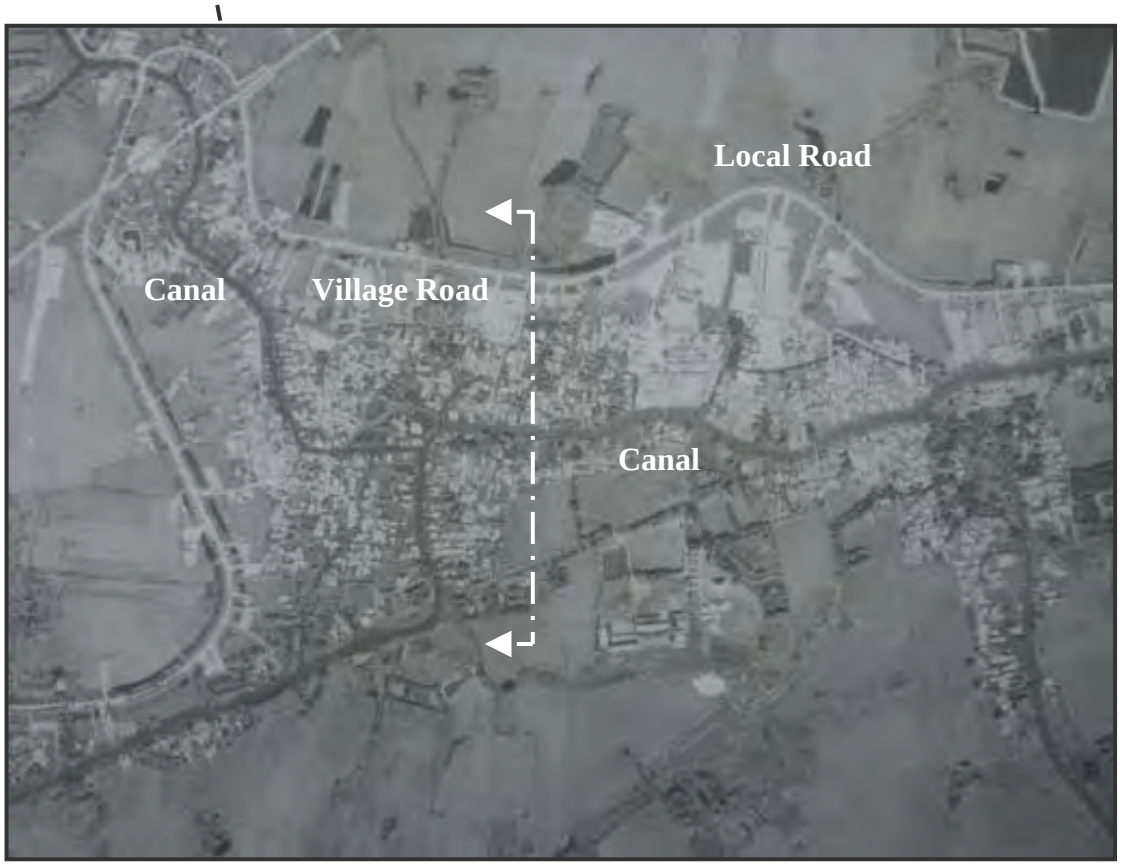
Figure 3.2.6 Site cross section of Pakkran village in 1950, 1975 and 2005



(a)



(b)



(c)

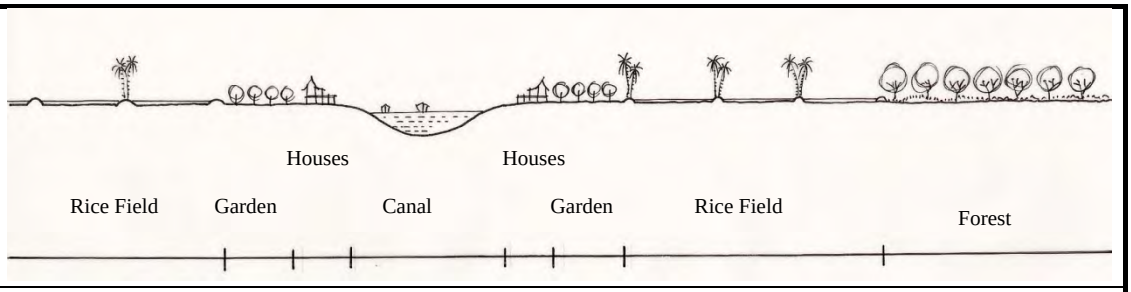
Figure 3.2.7 Ladchado village in 2005

(a) Location of the village and direction to the city centre

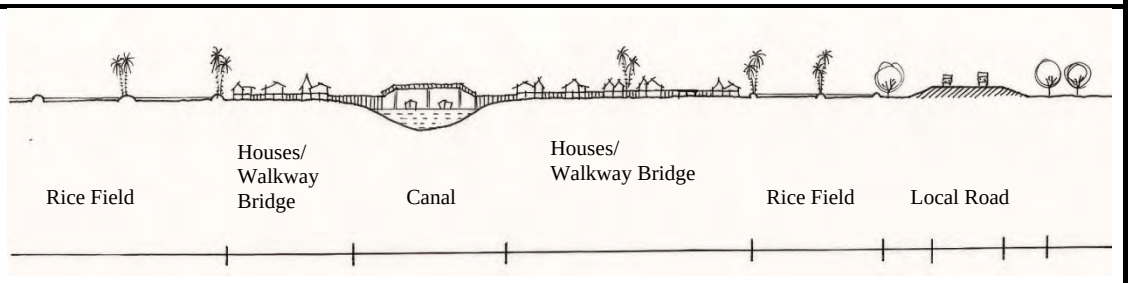
(b) Canals and road in the village

(c) Aerial photograph of the village

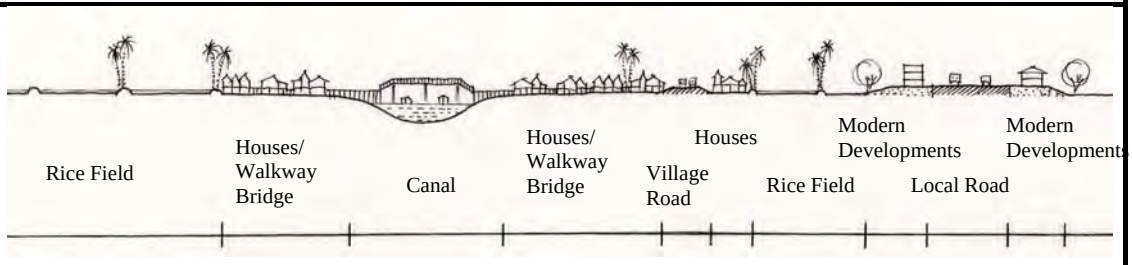
Source: Adapted by the author from *Division of Aerial Map Collection* of Thai Army, 2005



Year: 1800s
Appearances of the settlement:
-Linear settlement along the canal



Year: 1980s
Changes of the settlement:
-Extending of cluster settlement behind the linear settlement
-Beginning of the walkway bridge network
-Beginning of the local road close to the village



Year: 2005
Changes of the settlement:
-The asphalt road replacing the main walkway bridge in the village
-No flooding in some areas since the construction of the village road in 2002
-Beginning of modern buildings along the local road

Figure 3.2.8 Site cross section of Ladchado village in 1950, 1980 and 2005

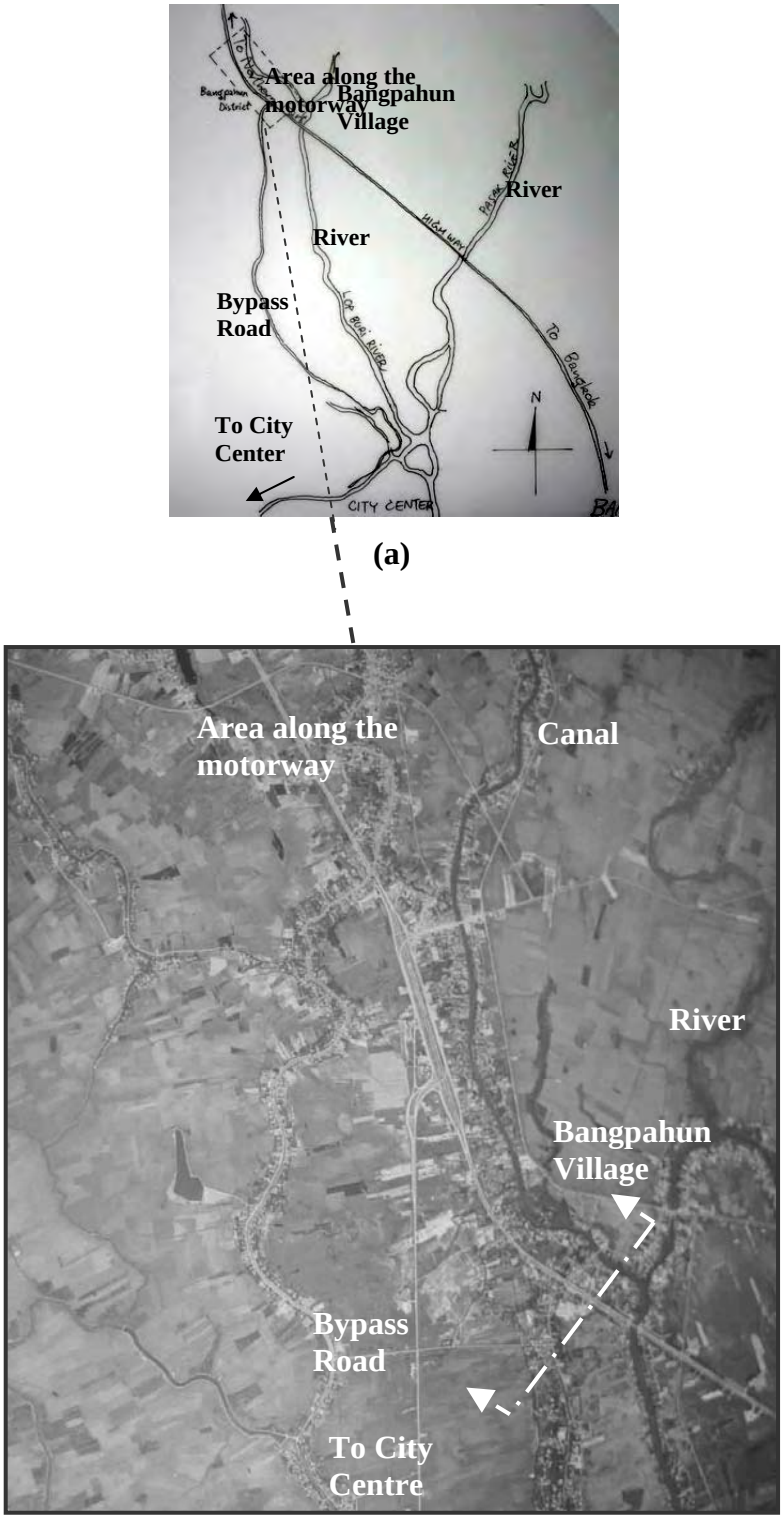
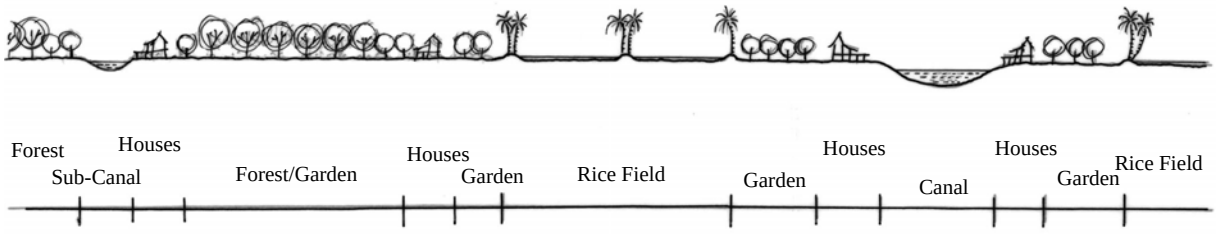


Figure 3.2.9 Bangpahun area in 2005

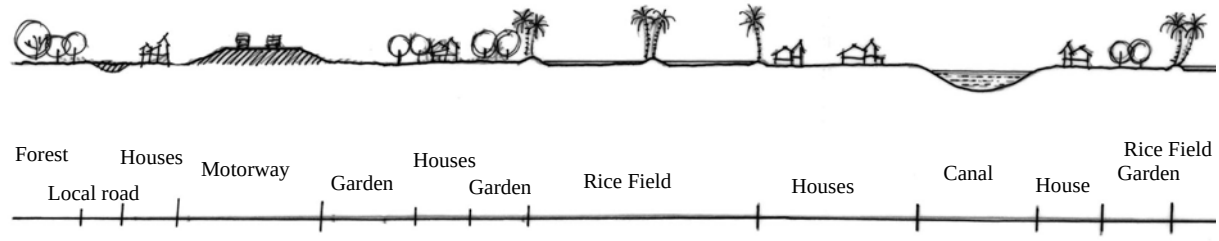
(a) Location of the area along the motorway comparing to the city centre

(b) Aerial photograph of the area

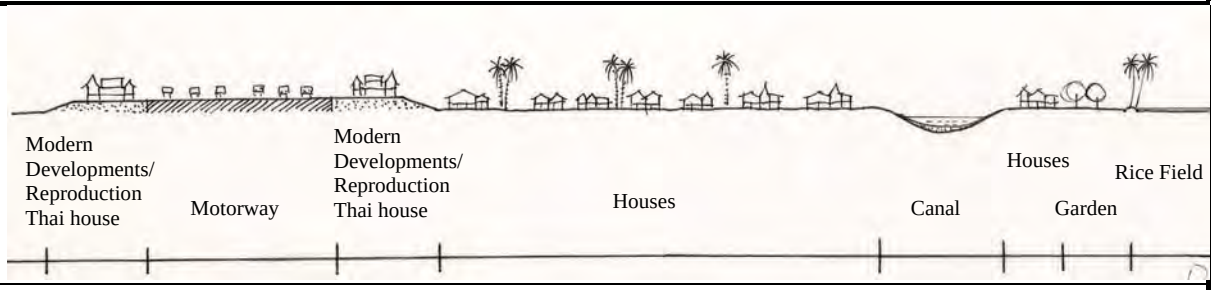
Source: Adapted by the author from *Division of Aerial Map Collection* of Thai Army, 2005



Year: 1950s
Appearances of the settlement:
- Linear settlement along the canal



Year: 1970s
Changes of the settlement:
- Extending of settlement behind the linear settlement
- Beginning of the motorway (2 lanes)
- Local road construction on the sub-canal



Year: 2005
Changes of the settlement and area along the motorway:
- Expansion of the motorway
- Cluster settlement with village road behind the linear settlement
- Local builders establish the workshops along the motorway
- Modern developments including the *reproduction Thai houses* along the motorway

Figure 3.2.10 Site cross section of Bangpahun village and the area along the motor way in 1950s, 1970s and 2005

3.3.1 Sampling process

The study mainly focuses on the *transforming Thai houses* (Figures 3.3.1-3.3.4) and the *reproduction Thai houses* (Figures 3.3.5-3.3.7). Selection of houses in Pakkran (urban district village), Ladchado (rural village) and Bangpahun (buffer area) are based mainly on the physical appearance and the uses of materials of vernacular houses, reviewed in Chapter Two. A number of vernacular houses are selected to explicate the difference or the similarity among those selected localities in Ayutthaya province. As already explained in sub-section 3.2.2, urban district and rural villages consist mostly of *the transforming traditional houses,* while *the reproduction traditional houses* are in buffer area.

This research selected the houses for further study in accordance with their local conditions. After the selection, the finishing process depends on the availability of the residents to be interviewed. These interviewees have to be able to reveal historical information of their houses. The number of respondents of each house is one person but may increase to two or three persons if information is not sufficient.

Accessing households after selection is one of the most difficult tasks in field research. The surveyor selects and directly contacts the residents of selected houses. This approach takes about 10-30 minutes to get permission. The residents always approve after talking with the surveyor and having verified the surveyor's status. Some interviewees introduced and led the surveyors to the other residents in nearby houses. This introduction reduced approaching time in several cases. The numbers of cases are decided from the total population, reflection of the various changes, and distribution of information. All of the above processes led to around 80 houses being surveyed, which are 33 households (6% of 550 houses) from the urban district village, 38 households (6% of 630 houses) from rural village, and 8 households (26.6% of 30 households from buffer area (see Figures 3.3.1-3.3.7). However, more than 20 cases were not used for some analyses because of inappropriate data.

3.3.2 Testing of the survey form

At an early stage of field research, testing of the survey form was to get feedback from team members and respondents concerning their understanding of the study. Six houses were selected for an overview of materials. The survey forms were written in Thai so as to communicate with the Thai team members. However, they

were later translated into English for documentation of the research. Since there were no records on the date of construction, it was necessary to rely on the respondent's information. After information from the techniques mentioned above was gathered, two groups of data were organized by the researcher, graphic and interview information. These data were used to improve the final survey form.

3.3.3 Gathering data

Interviews and observations are the main techniques for gaining data. Photographing, drawing and sketching provided a way to observe and record both interior and exterior of the surveyed houses (see Appendix C). Because there was no graphic documentation of all surveyed houses, every floor plan and elevation was sketched and measured during the visits (see Appendix D).

The graphic data of features were acquired from the measurement and rough sketches of the upper level, ground level and roof. After the field surveys, precise plans and elevations including construction details were produced. Data of period of modification and extension came from the interviews with household members.

3.3.3.1 Survey team and field work

There are six members including the researcher in the survey team. The research assistants were recruited among the students in the Faculty of Architecture, Thammasat University. All of them were the researcher's students in materials and construction class. The assistants were trained and clearly instructed on the methods of data collection. After that, they practiced with the researcher several times before visiting the study areas.

Team members divided the work into three parts. Each team member had to interview, sketch and take pictures. The interviewer asked residents the questions in the survey forms and wrote down the data. After the interview, the survey team members measured the house plans and sketched the house floor plans and elevations. When the rough sketches were completed, the member took pictures and measured the layout of the house and its surrounding areas.

After the survey was done in each trip, the research assistants returned the completed survey forms to the researcher. Problems were regularly discussed at the end of each survey day. Besides the period of field trip, each team member took about

twelve hours to accurately draw up plans, elevations, layout and details of construction of each house (see Appendix D).

3.3.3.2 Interview procedure

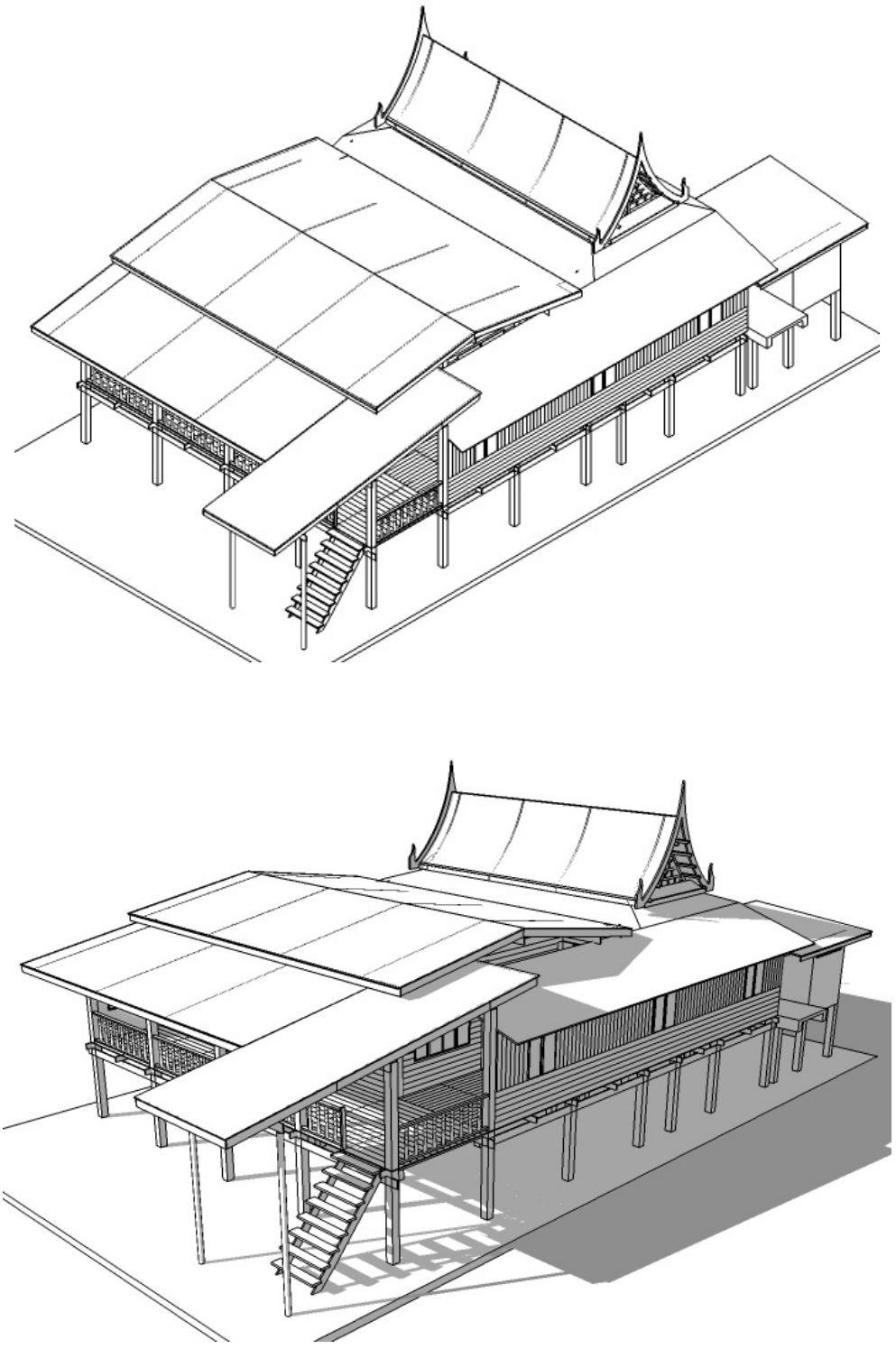
Interviews were used for revealing the time of house developments. For this research, both semi-structured and structured interviews were used. At the early stage of survey of each house, the semi-structured interviews were carried out to collect overall information and a brief background of the households. In this part of interview, the questions involved the beginning of village, the beginning of the *traditional Thai houses*, the relocation of the house, modifications and expansions. After that, the structured interview was carried out focusing on the uses of the materials and period of extensions or modifications of each house. The interview of this later part also included the questions about the residents' opinion and future of the houses.

The interview was conducted in selected houses. If there was more than one person in the house, the interviewer chose the family member, who could provide most information about the house and its history. Every selected house was visited at least two times within a period of intensive fieldwork, which was around six months. The interview process for each household normally took about 30 to 45 minutes but the observation and recording work always took between two to three hours. The period of time depended on the size of the house, the complexity of house form, historical development and its environment.

3.3.4 Documentary data

In this study, primary sources of information about the research site were obtained from the municipal records and annual report prepared by government agencies. Aerial photographs were provided by the *Military Department of Thai Army for the Interior Defence, Division of Aerial Maps Collection* in Bangkok, and used as a reference for conducting the field research. In addition, municipal officers were interviewed for history and background of the study areas.

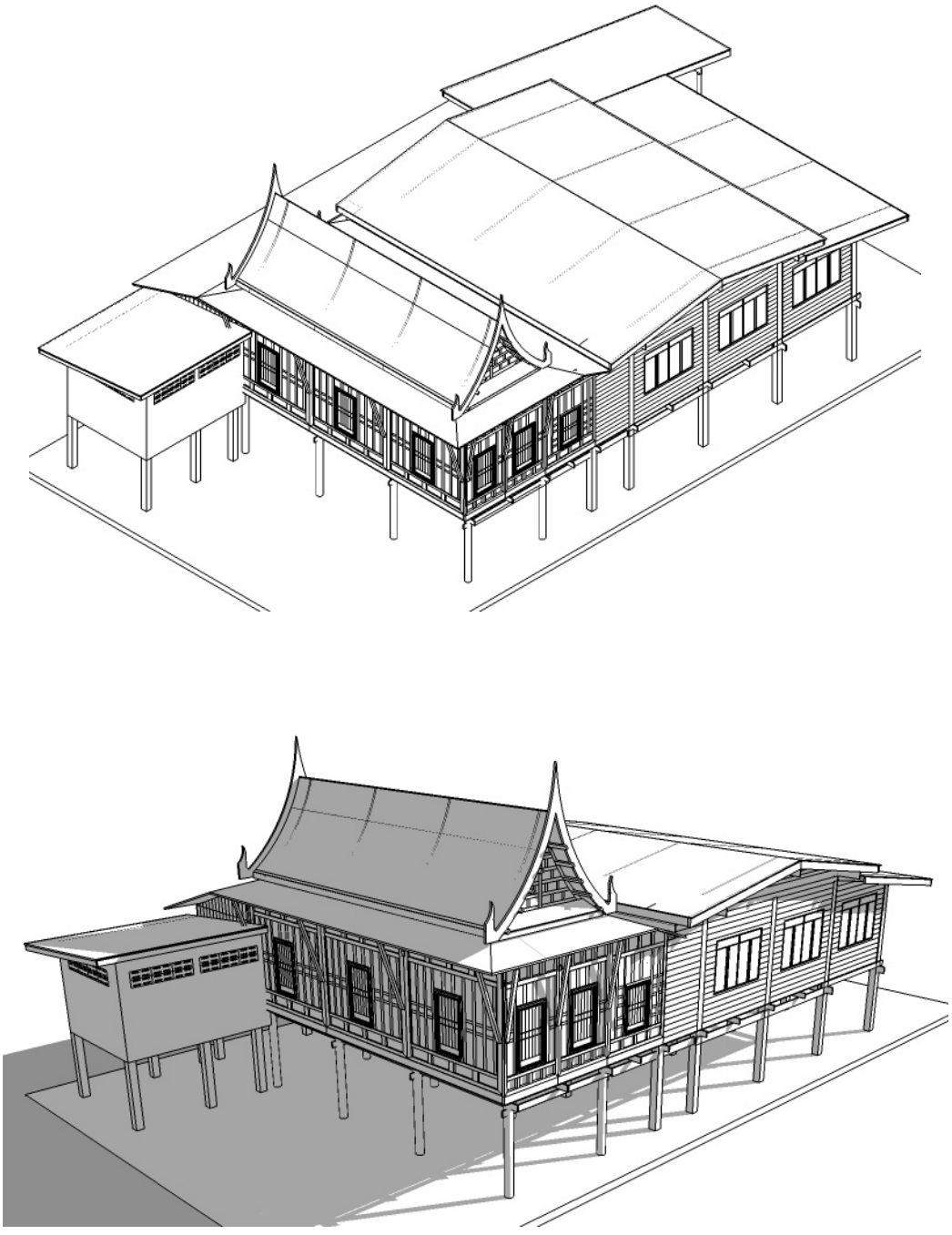
Transforming Thai House



Source: House no. P-PK-01

Figure 3.3.1 Front views of the *transforming Thai house* in the urban district village

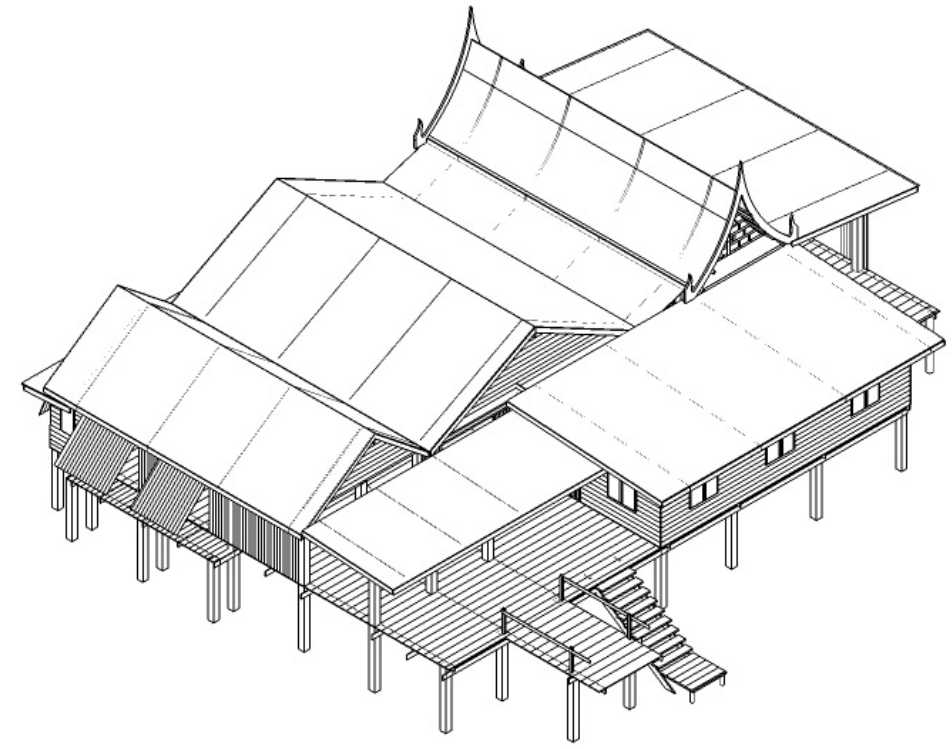
Transforming Thai House

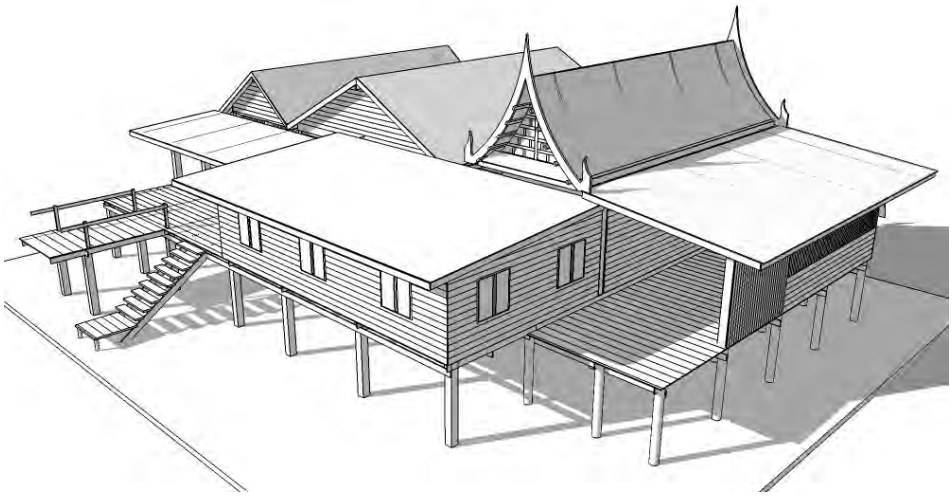


Source: House no. P-PK-02

Figure 3.3.2 Back views of the *transforming Thai house* in the urban district village

Transforming Thai House

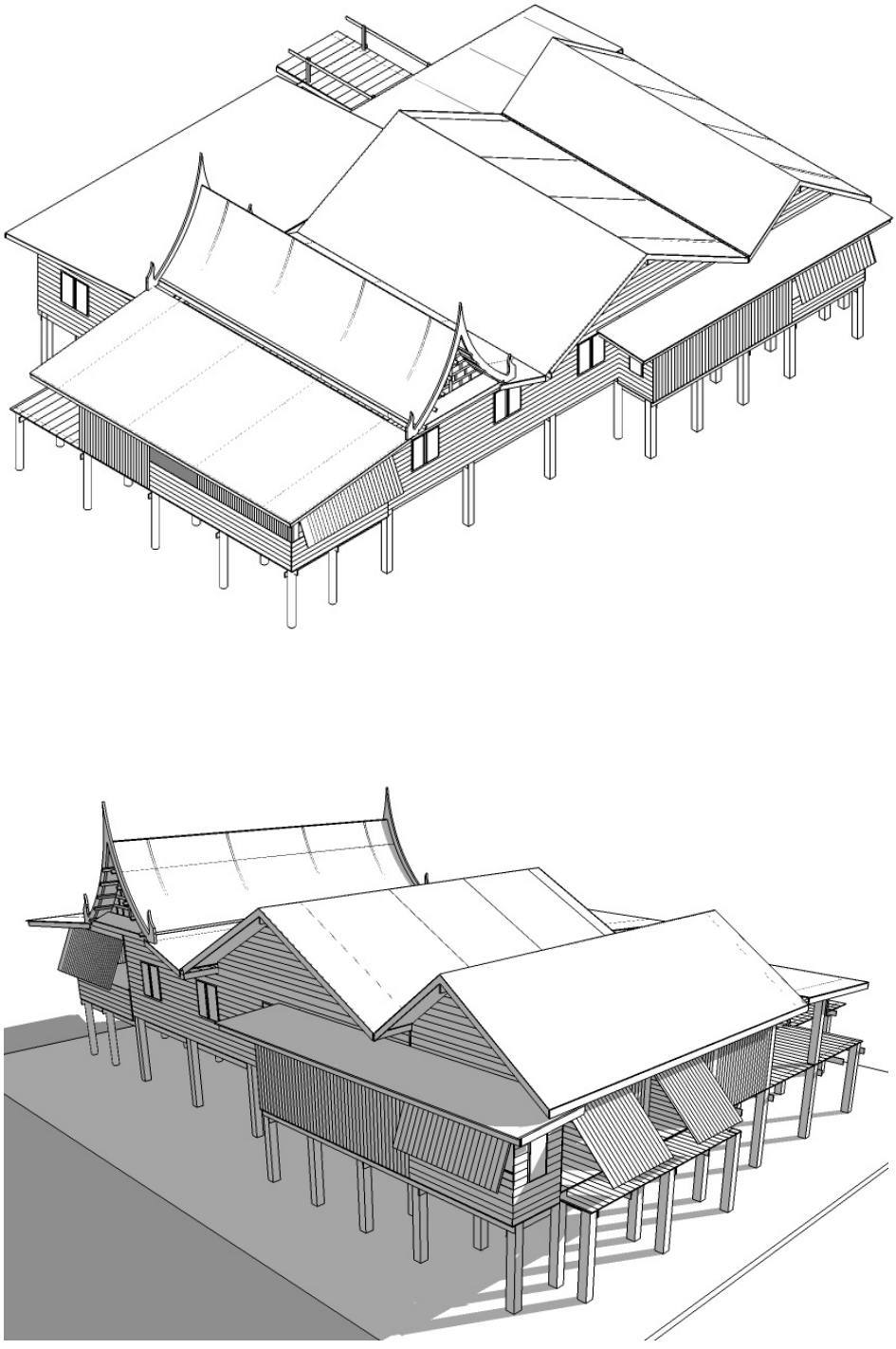




Source: House no. E-LD-10

Figure 3.3.3 Front views of the *transforming Thai house* in the rural village

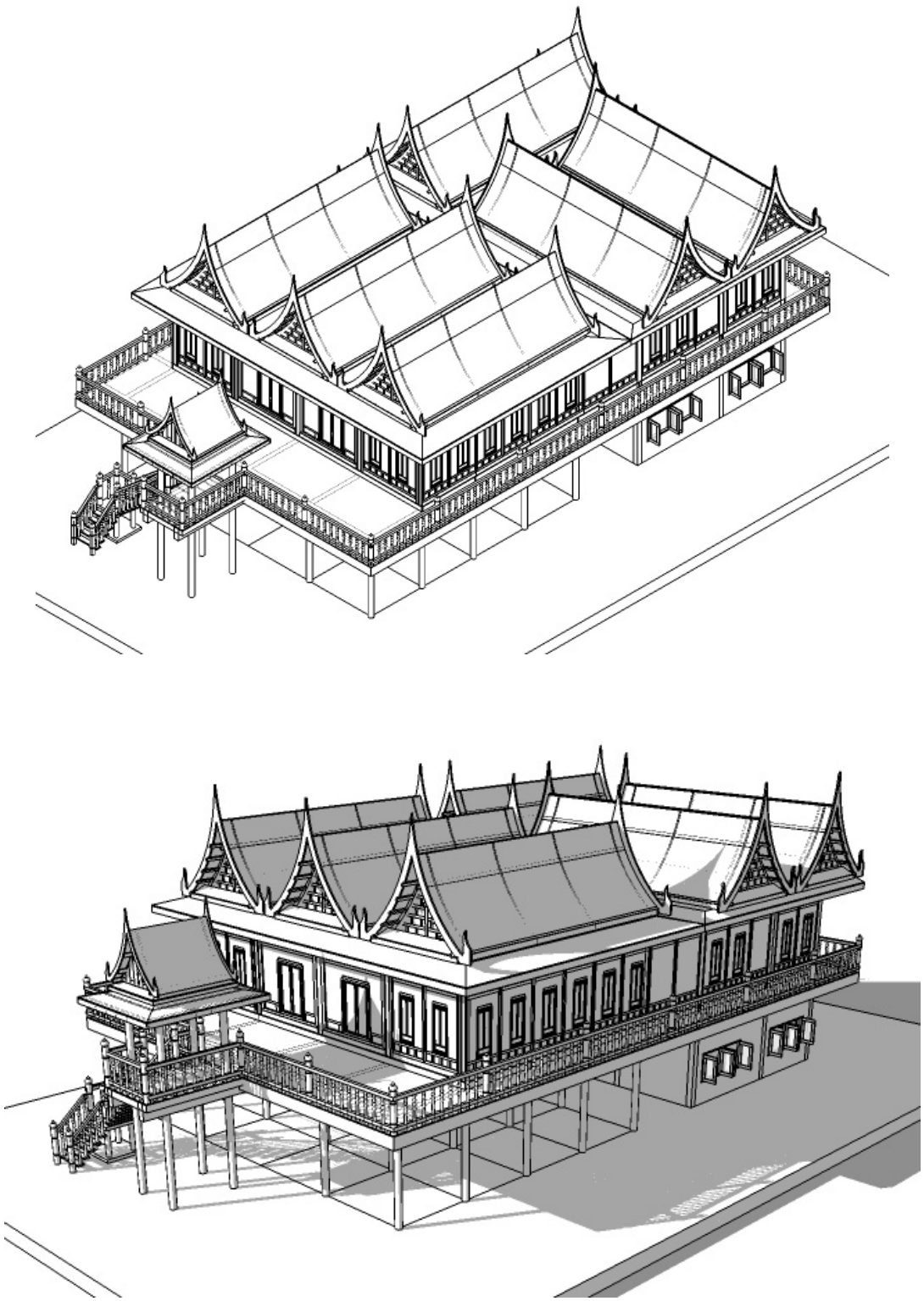
Transforming Thai House



Source: House no. E-LD-10

Figure 3.3.4 Back views of the *transforming Thai house* in the rural village

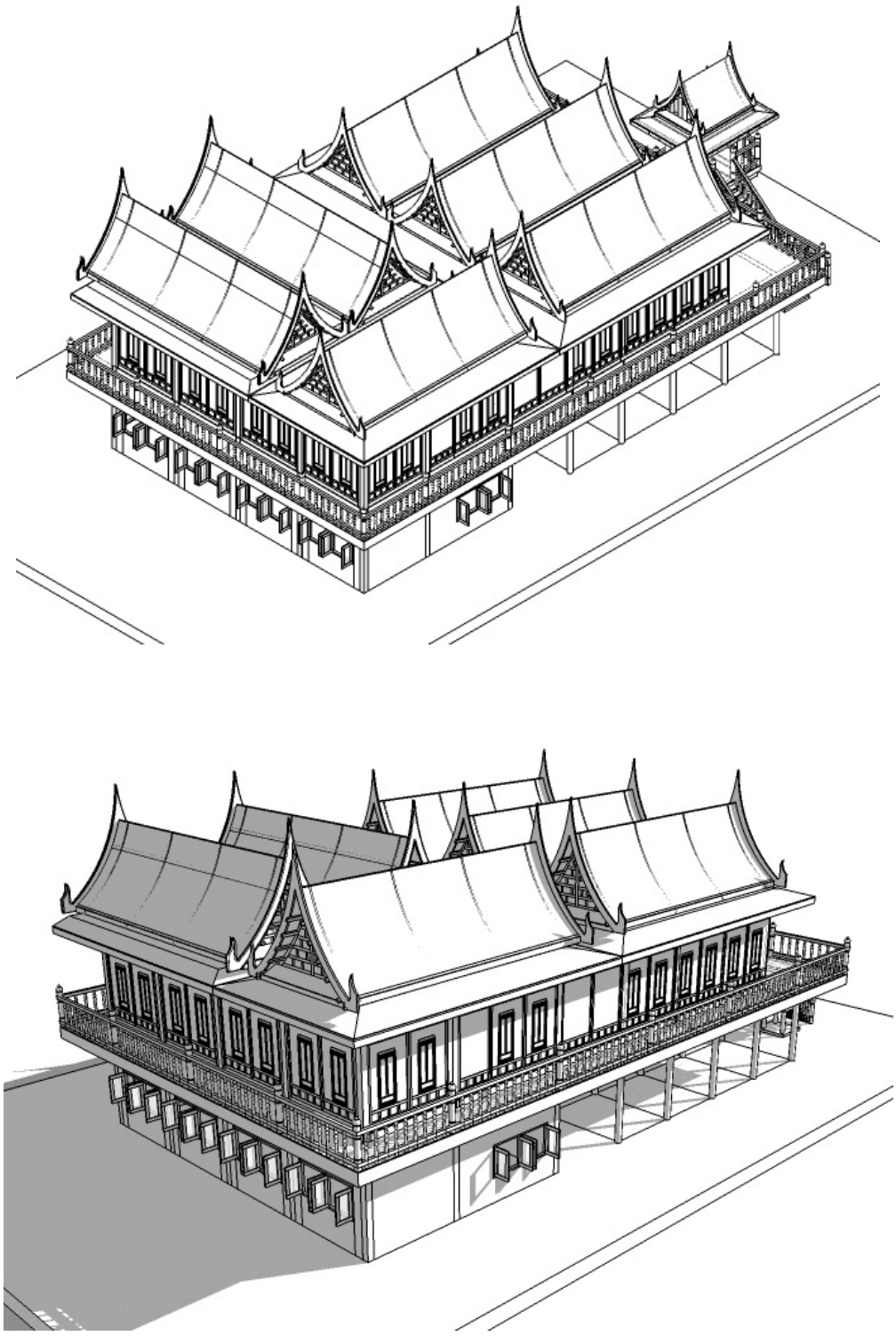
Reproduction Thai House



Source: House no. C-BH-12

Figure 3.3.5 Perspective front views of the *reproduction Thai house* in the buffer area

Reproduction Thai House



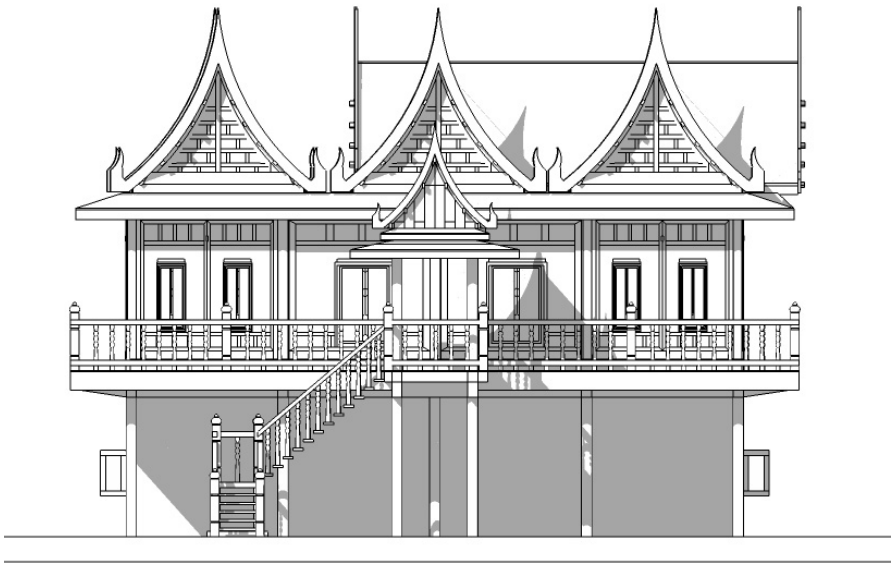
Source: House no. C-BH-12

Figure 3.3.6 Back views of the *reproduction Thai house* in the buffer area

Transforming Thai House

Transforming Thai House

Reproduction Thai House



Source: House no. P-PK-01, E-LD-10, and C-BH-12

Figure 3.3.7 Elevations of the transforming Thai houses and the *reproduction Thai house*

Various other supporting data was collected from various government agencies: demographic information, reports about changes in the environment and surrounding areas of the locality such as information of floods occurring around the studied areas as well as the development of roads, and other information that could bring about changes to the vernacular houses.

3.4 Methods of data analysis

The study involves the methods for analyzing two major changes: house transformation; and changing use of materials. In three study areas, around 80 samples were selected to be representatives of the vernacular buildings. Typological analysis has been frequently applied to the study of vernacular building (Oliver 1997) and is the main method used in this research. Besides typological analysis, statistics and residents' narrations were used to clarify the historical developments of the studied houses. The data from residents' narration were used to reveal the information which could not acquired from observation. The analyses are also based on constant comparative study.

Typological analysis is a method for distinguishing and sorting in time and place. Moneo (1998) stated that classification or typology is not only a system of dividing things into different types, but also an analytical tool for establishing the idea of continuity and process of change in architectural form with time.

To analyse the transformation, house construction is presented by various types of drawing. Elevations, plans and cross sections are taken into explanation. Three dimensional drawings are also the features to reveal more clarifying process of transformation. Along the drawings, observation and interview data are used. The classification of main spaces and physical appearance are initially based on the previous researches but adapted to suit the condition of the samples.

To study changing use of materials, the construction elements are classified into three groups: roof, upper level and ground level. Each construction element is analysed by typologies which are the results of data from observations and interviews. Three periods of development used for grouping the materials and methods of construction are tradition, early industry, and contemporary. The time-scale chart is developed to measure occurrences of change with time.

The analysis in this thesis involves the description of percentage from the samples, which are presented by pie and bar charts. The data were acquired from observations, the residents' narrations and opinions. Statistics is the methods of analysis which provides a general overview of the results. This supports some results from the typological analysis.

The typological analysis involving statistics and residents' narrations and opinions are also based on constant comparative study, which concerns the comparison between groups in different settings. It can show the significant difference of physical appearances and uses of materials between various areas. This study is hypothesized that Thai vernacular houses in different localities will be in different characteristics and degrees of retaining their tradition.

In the comparative study, the researcher selected comparable groups of villages or comparable physical environments and then collected data on a variety of related variables. The primary purpose is to determine the differences of uses of materials between the physical distinctiveness and location of villages or areas.

3.5 Conclusions

This chapter explains three subjects: selections of research sites, methods of data collection, and methods of data analysis. The site selections, research procedures for data collection, which were mainly completed in 2005, are presented.

Ayutthaya province in central Thailand was selected as the best location for this study. This was because although Ayutthaya nowadays is facing with the intrusion of modern development, it is one of the best locations of many vernacular houses that are still remained. Three areas with different conditions of development were selected in order to obtain various types of vernacular houses, as well as various conditions of changes in those houses. Those three settings are in urban district village (Pakkran), rural village (Ladchado) and modernized buffer area (Bangpahun). These three sites introduce both *the transformation traditional Thai houses* and *the reproduction traditional Thai houses*.

The methods of data collection were composed of three main procedures: sampling process, pilot study and data collection. Four types of primary data collection were 1) Uses of materials and construction elements; 2) Historical data; 3)

The residents' opinions; and 4) Shapes and forms of the houses. These data were collected by using the methods of observation and interview. Secondary data were drawn from government agencies and military department.

Data gained were analysed through typological analysis, statistical analysis, and constant comparative analysis. The residents' narrations and opinions were also used to illustrate the changes of those contemporary vernacular houses in the selected areas.

Chapter 4
Changes of the Vernacular Thai Houses

4.1 Introduction

As described in Section 2.3, vernacular houses have changed rapidly, especially during the last few decades, because of the deficiency of traditional materials and the availability of modern materials as well as construction technology. This change has resulted in different features and architectural details of those houses in a particular locality. As discussed in Section 3.2, the vernacular houses in this study are categorized into three types: the *traditional Thai house;* the *transforming Thai house;* and the *reproduction Thai house.* For this research, the *traditional Thai house* is followed the patterns appeared in the studies of Thai scholars, and used as an archetype to compare changes occurring in vernacular houses in the studied areas. Both the *transforming Thai houses* and the *reproduction Thai house*s have derived from the *traditional Thai houses,* but developed from a different basis. The *reproduction Thai house* is a new development that can indicate the trend of the vernacular houses, while the old house found in the *transforming Thai house* is categorized as one of the Thai heritages. Therefore, the transforming houses provide important resources of architectural development in Thailand.

The *transforming Thai houses* are a combination of traditional house and modern modification or extension. The residents have stopped using traditional materials and chosen to use new materials due to availability and limited budget. Though having a modern look with its extension part, the transforming houses are usually constructed with local knowledge and cheap labor. Even though the *reproduction Thai houses* are also built by merging traditional with modern appearance, they are newly constructed with more recent methods and redesigned in the whole building. These reproducing houses are built by builders who live and professionally practice in nearby vernacular villages.

This chapter is particularly concerned with the *transforming Thai houses* in order to clarify the process of change in their physical appearance. The chapter also aims to explain the key features, the major transformations of vernacular houses related to the construction elements, and the causes of the beginning of recent

vernacular houses. The explanation of this chapter begins with typological analysis in Section 4.2. This part also explains the crucial work prepared before the on-site survey and the sources of the acquired information. The main parts of the houses are clarified, and their functions are explained in Section 4.3. An archetype of *traditional Thai houses* is described in Section 4.4. The major transformations of vernacular houses including their construction elements in the urban district villages and the rural villages are then analyzed in Section 4.5. To compare with the study of transformation, the development of the *reproduction vernacular houses* in the motorway buffer areas is described in Section 4.6. Conclusions are drawn in Section 4.7.

4.2 Typological analysis of the change

The concept of typology is an important analytical tool for investigating the idea of continuity and the process of change in architectural form with time. Although there are about 80 houses surveyed in the three locations, only 57 houses were selected for analysis in this chapter. As described in Section 3.4, the information was derived from direct house observation and interviews in 2005 with the households: 21 samples in Pakkran (urban district village); 30 samples in Ladchado (rural village); and 6 samples in Banpahun (buffer area) (see plans and elevations in Appendix B). Fifty-one of the houses recorded belong to the class of *transforming Thai houses* and the rest are *reproduction Thai houses*.

Grouping of construction elements was carried out prior to the field research in order to avoid confusion during the on-site observation. From a review of previous studies, the elements were classified into two primary groups: structure and cladding. The structural group is comprised of foundation, columns and beams at ground floor level and upper floor level, and roof structure. The cladding group is comprised of walls and flooring materials at ground floor level and upper floor level, and roof cladding.

Components of the houses are illustrated by photos and drawings. The images and various types of drawings, such as isometrics, plans, elevations and cross sections, are emphasized by shading, line and arrow. Simple statistics are used to show the general trend of construction element sizes and years of development. The

charts and tables illustrate the difference between the vernacular houses and the archetype.

The analysis is comprised of five main steps:

1. Classify the main parts of the vernacular houses from previous studies and indicate their transformation;
2. Define the archetype;
3. Group the construction elements, which will be discussed in material subjects;
4. Discuss the transformation and data from the survey that relates to the construction elements;
5. Point out those essential issues about materials of the recent vernacular houses.

4.3 Classification of spaces and functions

For the purpose of studying the modification and growth of the house with time, the housing is divided in ground level and upper level. Table 4.3.1 provides a classification of internal and external spaces for the residence, identifying principle function and major change relating to use and materials.

The physical appearances of the four types of the vernacular houses in the study areas are illustrated in Figures 4.3.1 to 4.3.5. The main spaces are represented by numbers 1 to 7 in three views: plan, isometric and section of the houses. The traditional buildings are shaded for comparison of various house types. With this technique, the *traditional Thai house* is fully shaded while the *reproduction Thai house* is clear from the shade. The *transforming Thai houses* which are the main aim of this study are drawn from two vernacular villages, the urban district and rural villages. These houses are shaded at the remaining original parts and clear at the extended or modified parts.

The classification of the main parts is based on the documentation by previous researchers. The studies conducted by Pinijvarasin (2004) and Thungsakul (2001) are amongst the useful sources. The explanations of the functions and features are summarized from the interview and survey in 2005. The reasons of the change will be discussed in Section 4.5.

Table 4.3.1 Functions and change of spaces of the vernacular Thai houses

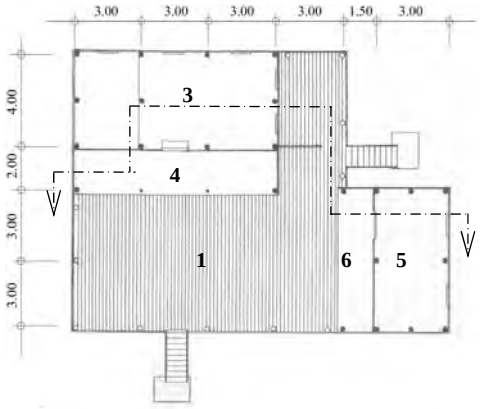
Space	Level	Function	Change
1. Central terrace	Upper	Socializing, living and working	- From modify central terrace to the hall (Outdoor to enclosed space) - From multi-level to single level floor
2. Area under a raised dwelling	Ground	Socializing, living, working and eating / No function in some seasons or some areas	- Added ground level room - Earthen floor to concrete floor
3. Bedroom unit	Upper	Sleeping and storage	- Link directly to the hall instead of the intermediary of verandah
4. Verandah	Upper	Socializing, sleeping and eating	- Combined to be part of the hall - Build porch at front
5. Kitchen unit	Upper	Cooking	- From separated unit to part of the hall
6. Dining area	Upper	Eating	- From verandah and terrace to the hall
7. Bathing area	Ground/ Upper	Bathing and Sanitary	- From outside to inside

4.3.1 Central terrace

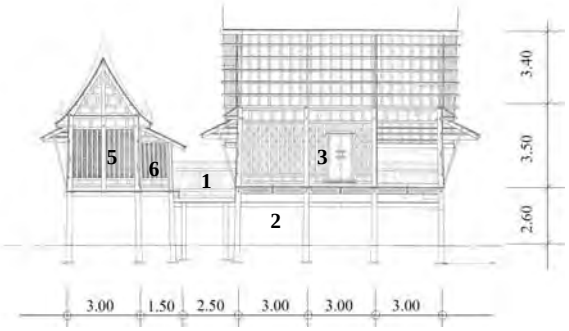
This part is the core for circulation and activities in the *traditional Thai house*. Since the bedroom and kitchen are separate units, ventilation is maximized through the walls. In some examples, the area of building unit is less than the area of central terrace. In the *transforming Thai house*, the central terrace is enclosed to form a hall. It is usually used for many purposes such as family socializing and entertaining, watching television, and finishing schoolwork. In the *transforming Thai house*, the hall is also a sleeping part for family members, relatives and very close friends of family members.

Archetype of the Traditional Thai House

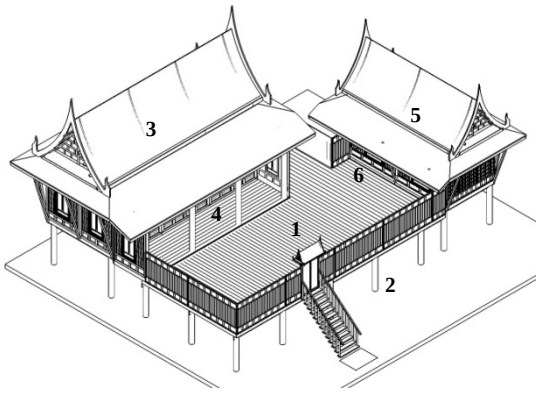
Plan



Section



Isometric



Key:

1. Central terrace
2. Area under raised floor
3. Bedroom unit
4. Verandah
5. Kitchen unit
6. Eating part

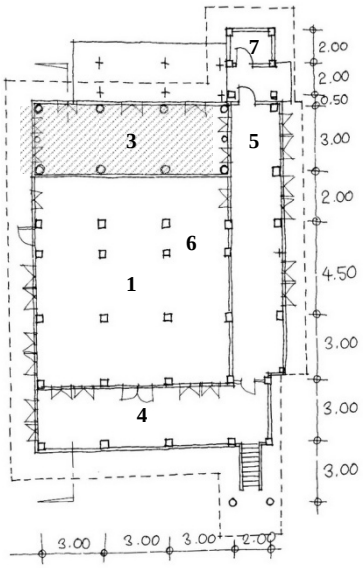
Source: Adjusted from Jaijongrak, 2000

Remark: The upper level area of this house is 171 sq. m.

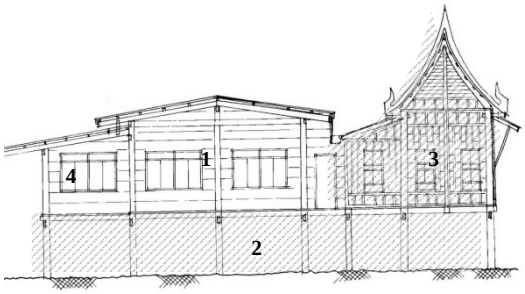
Figure 4.3.1 Plan, Isometric, and Section of the archetype of the *traditional Thai house* in Central Thailand

Transforming Thai House in the urban district village

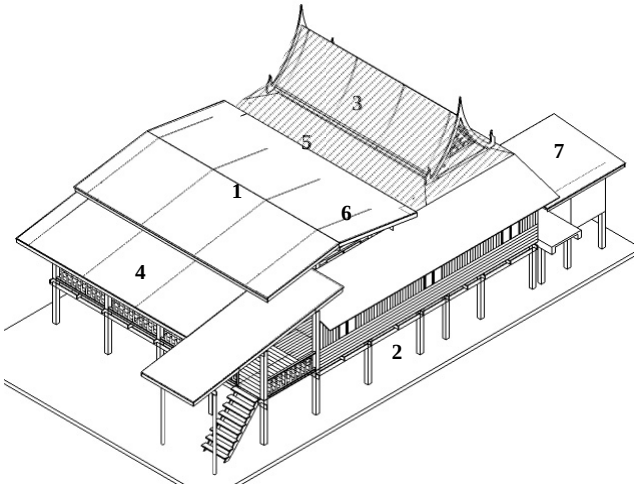
Plan



Section



Isometric



Key:

1. Hall
2. Area under raised floor
3. Bedroom unit
4. Porch
5. Kitchen unit
6. Eating part
7. Bathroom

Note: The original buildings are shaded.

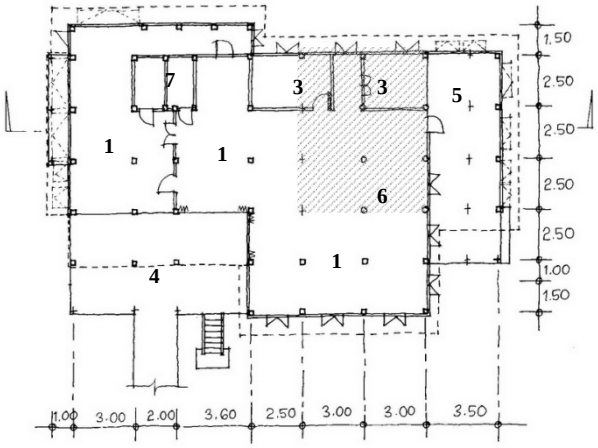
Source: House no. P-PK-01

Remark: The upper level area of this house (179.5 sq. m.) is close to the averaged upper level area of the transforming Thai house (150.7 sq. m.) in the urban district village (Table 4.5.2).

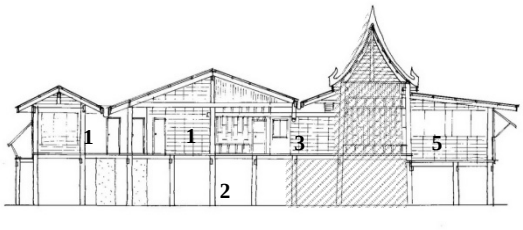
Figure 4.3.2 Plan, Isometric and Section of the *transforming Thai house* in the urban district village

Transforming Thai House in the rural village

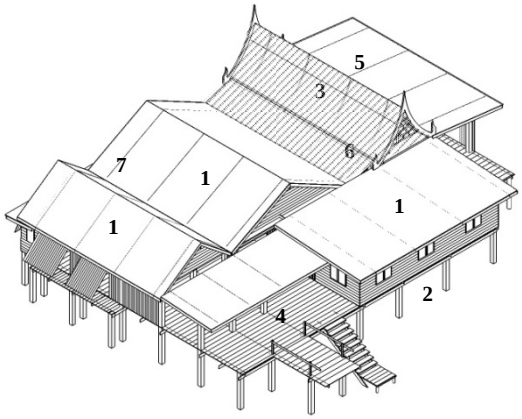
Plan



Section



Isometric



Key:

1. Hall
2. Area under raised floor
3. Bedroom unit
4. Porch
5. Kitchen unit
6. Eating part
7. Bathroom

Note: The original buildings are shaded.

Source: House no. E-LD-10

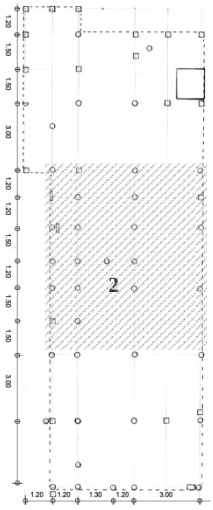
Remark: The upper level area of this house (269.1 sq. m.) is larger than the averaged upper level area (203.2 sq. m.) of the transforming Thai house in the rural village (Table 4.5.2).

Figure 4.3.3 Plan, Isometric and Section of the *transforming Thai house* in the rural village

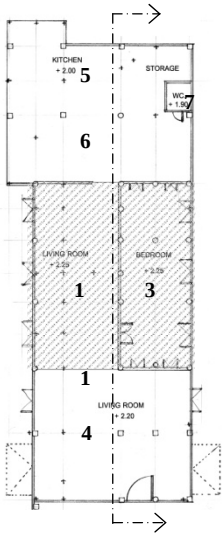
Transforming Thai House in the rural village

Plan

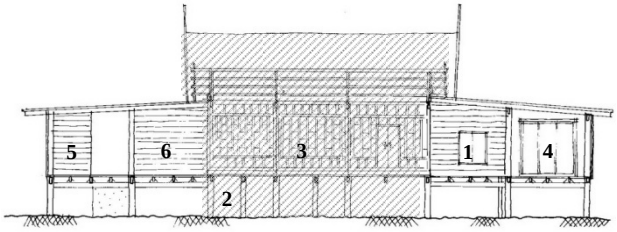
Ground level



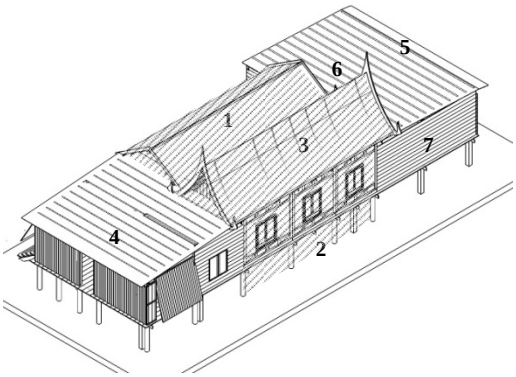
Upper level



Section



Isometric



Key:

1. Hall
2. Area under raised floor
3. Bedroom unit
4. Porch
5. Kitchen unit
6. Eating part
7. Bathroom

Note: The original buildings are shaded.

Source: House no. U-LD-06

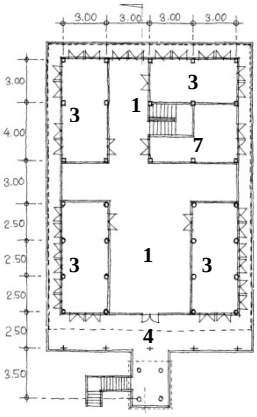
Remark: The upper level area of this house (162.5 sq. m.) is smaller than the averaged upper level area (203.2 sq. m.) of the transforming Thai house in the rural village (Table 4.5.2).

Figure 4.3.4 Plan, Isometric and Section of the *transforming Thai house* in the rural village

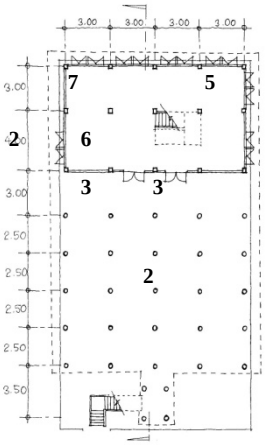
Reproduction Thai House in the buffer area

Plan

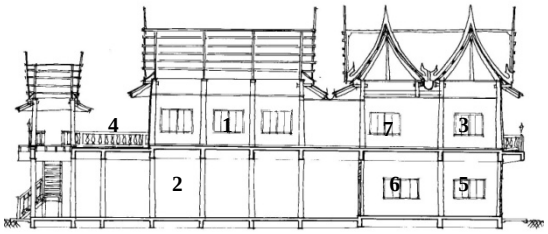
Upper level



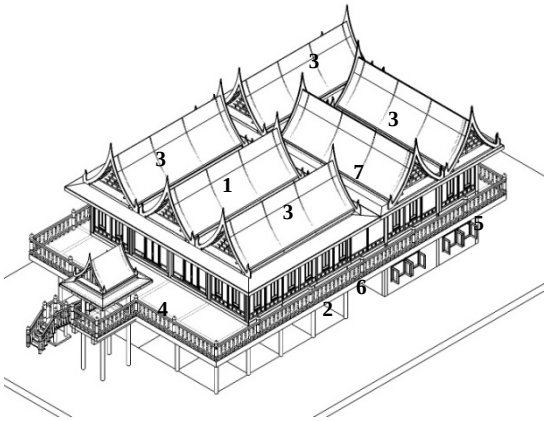
Ground level



Section



Isometric



Key:

1. Hall	5. Kitchen
2. Area under raised floor	6. Dining room
3. Bedroom	7. Bathroom
4. Porch	

Source: House no. CH-BH-12

Remark: The upper level area of this house (301 sq. m.) is close to the averaged upper level area of the reproduction Thai house (281.7 sq. m.) in the buffer area (Table 4.5.2).

Figure 4.3.5 Plan, Isometric and Section of the *reproduction Thai house* in the buffer area

4.3.2 Area under a raised dwelling

In daytime, the area under the building is a common area for daily routines. In the afternoon, a shady space in this area is the most comfortable to live, as the temperature rises. This part is built without walls and is composed of a raised platform on top and an earthen floor. In many functions, it could be swapped with the central terrace. Furthermore, it provides ventilation for the residents at the upper level through floor gaps and steps. During floods, it becomes a place to moor boats. Activities include food preparation, child care, socializing with neighbors, receiving guests, handicraft work and domestic tasks. Some houses use this area for relaxing, car parking, selling goods, and storing agricultural products and equipment. The area could also be used to keep cattle, pigs and poultry. However, the mentioned functions do not happen in some locations. Some villagers prefer to live at the upper floor because of many reasons such as belief, enough space (at the upper floor), and improper land condition (muddy and dirty) after flood.

4.3.3 Bedroom unit

The sleeping areas can be located in many parts of the upper level. One of the sleeping areas is a bedroom unit. It is a closed part without accessibility from visitors. In most houses, residents sleep on mattresses laid over mats and under mosquito nets. In the *traditional Thai house*, all family members sleep in the bedroom unit with a separate room provided for daughters, which is a very private zone. This room is also used as a spirit room and storage room for precious belongings. During hot season, sleeping may sometimes take place in the verandah for better ventilation. The bedroom is leaved and mainly used for praying and storage. In the *transforming Thai house*, most of the households stated that they sleep in the hall. Therefore, the sleeping area is not only the bedroom because the activity could take place in other areas.

4.3.4 Verandah

The verandah is one of the dominant parts of traditional houses in Thailand because it appropriately responds to the traditional Thai life style. In the *traditional Thai house,* it is normally located between the bedroom unit and the central terrace. The verandah is partially-covered, shaped as a strip platform and raised from the central terrace. It functions as a transitional space for the multi-level floor. Many

activities are performed in this portion, including taking a rest or nap. It is also regarded as an informal place for family living. The verandah is sometimes used for receiving guests who have a close relationship with family members. The verandah is kept clean so that it can be used for sitting or reclining (Jaijongrak 2000).

4.3.5 Kitchen unit

The kitchen unit typically is located at the back of the house, at the corner of the central terrace or hall. Furthermore, it is sometimes located on the northern side of the building because of the direction of the wind from the south. If the family could not afford to have a kitchen, the verandah has to be used as a temporary kitchen. However, it is typical to have a separate kitchen to: prevent fires; separate living parts from smell, dirt and ashes created from uses of charcoal; separate the orderly living parts from the untidy cooking area; better ventilate the bedroom unit; and divide the activities of men and women (Jotisalikorn 2000). The residents explained that the usual meals are prepared in the kitchen but the important meals usually are prepared in the area under the dwelling. These meals are for family on festival days or for formal guests. The family may spend more than half a day for the food preparation. Some cooking requires assistants, large space and outdoor area.

4.3.6 Dining area

As in other Southeast Asian cultures, the residents usually rest, sit and eat on the floor which is kept carefully clean. The residents and visitors have to remove the shoes when entering a house. There is no unit or area functioning as a dining room either in the *traditional Thai house* or the *transforming Thai house*. The eating activities take place both on the verandah and central terrace. In a transformed house, this part is located in the hall close to the kitchen unit. Some meals could be arranged under the dwelling when there are social ceremonial events.

4.3.7 Bathing area

In the traditional house, there is no bathroom or toilet. To relieve themselves, people went to the fields or used a vessel and threw the waste away. Bathing is probably done in the river, canal or on the terrace. The construction of new parts usually includes a bathroom inside. Most of them are built at the upper level and

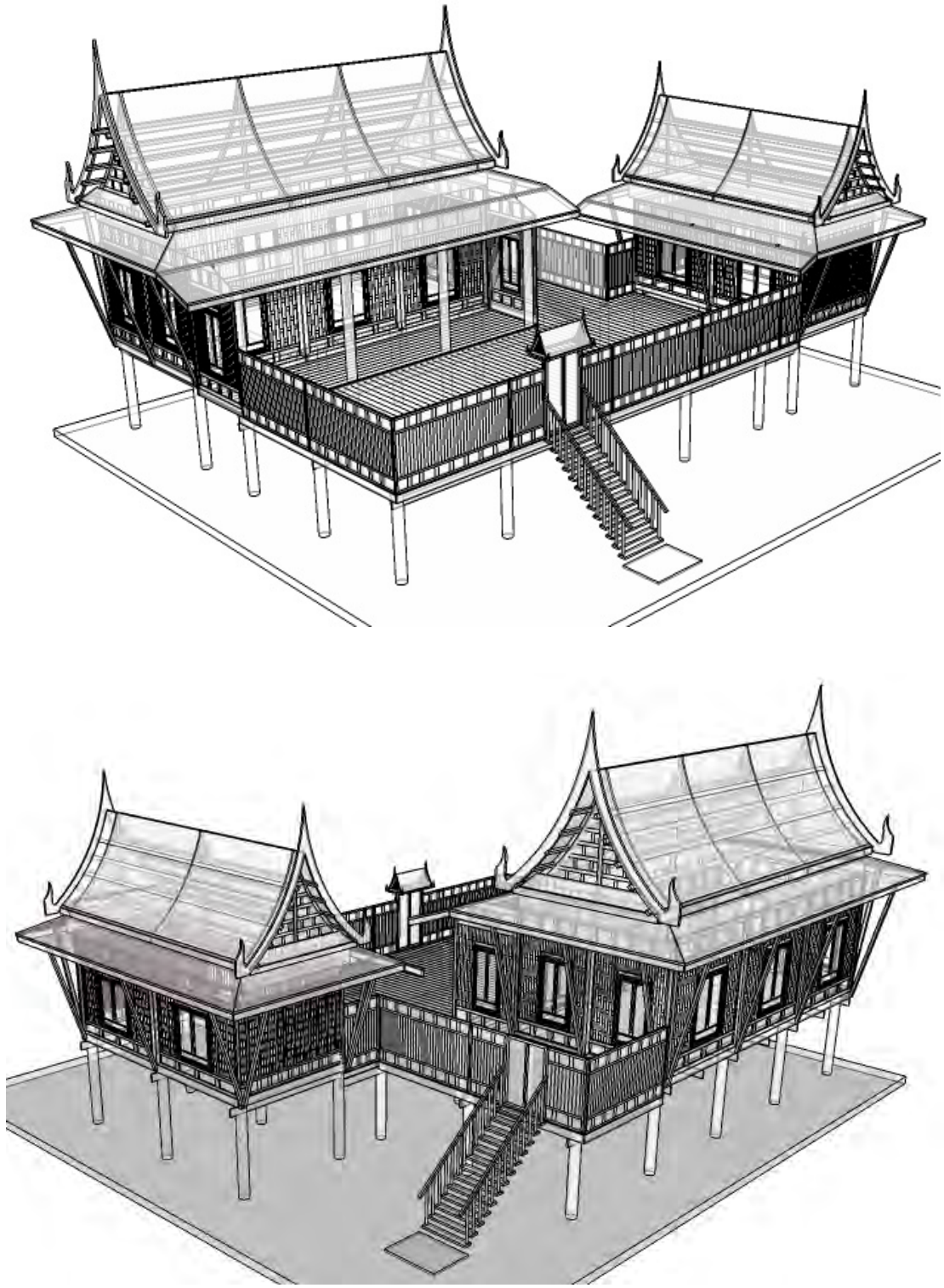
attached to the central hall. Additionally, some bathrooms are located at the ground level at the back of the house.

4.4 Archetype of the traditional house in study areas

From the previous studies in Section 2.2, there are many types of vernacular building in the country. The archetype of the vernacular building in each area is different but could be grouped as five main types: Northern, Eastern, Central, Southern style, and Ethnic group or Hill tribe. Exclusively, only the vernacular house with the Central style is named the *traditional Thai house*. In the study areas, a few vernacular houses classified as the *traditional Thai house* remain. Although the remaining examples are in a compact cluster composed of bedroom units and a kitchen unit around a central terrace, these houses show the essence of the *traditional Thai house*. A few *traditional Thai house*s, classified as an archetype, are found in the urban district village (see Figure 4.4.1). The archetype is used for measuring and understanding the changes in Chapters 4 and 5.

Figure 4.4.1 The *traditional Thai house* in the urban district village with minor changes at bathrooms (A) and roof cladding (B)

As discussed concerning the vernacular building in Thailand in Section 2.2, there are many variations of the house style, ranging in size from a single-family house to an extended family house. The smaller house consists only of a bedroom, a kitchen and a strip terrace, while the cluster house may have up to five or six bedroom units arranged around a central terrace. In the study areas, the *traditional Thai houses*



Source: House drawn from data by Jaijongrak, 2000

Note: No construction of beam, wall, and floor at ground level in an archetype

Remark: Illustrated only at some parts of the house.

Figure 4.4.2 The *traditional Thai house* and construction elements

are timber buildings with high-pitched roofs and lifted above the ground (Figure 4.4.2). They were built from prefabricated sections that can be dismantled and reassembled. The building compound consisted of several separate buildings. These buildings were clustered around a central terrace which was the core of the whole dwelling.

The extended family system enlarges the housing compound by increasing the number of new buildings. One unit of the building is composed of a bedroom, a verandah and a part of the terrace which is attached to the central terrace (Piromya, 2000)

In some occasions, if family members want to start their own household or need to relocate, these additional buildings could also be moved away to form a new house. Because they were built mostly of prefabricated components, the *traditional Thai houses* are easily dismantled and transportable.

Without any panel, the area underneath the house is open and has multiple uses. Access to the house is by a staircase which leads to the terrace. There are two types of buildings, bedroom unit and kitchen unit, which are clustered around the terrace. The buildings are built with columns inclined inwards on all sides.

In a housing compound, a bedroom unit may be increased from one to five units or more. Inside, the bedroom unit can be divided into two spaces, sleeping and praying. The bedroom unit is usually attached to a verandah, an intermediary space. Floors are raised into three levels: the bedroom; the verandah; and the central terrace. The walls are of two types; wooden infill wall and bamboo infill wall (Figures 4.4.3 and 4.4.4).

Figure 4.4.3 Wooden infill wall of the traditional Thai house

Figure 4.4.4 Bamboo infill wall of the traditional Thai house

Figure 4.4.5 Ventilated wall with grass infill behind wooden studs

The kitchen unit is usually composed of one building in a housing compound. Some kitchen unit is attached to the verandah similar to the bedroom unit. The floor level is always raised from the terrace. Panels are usually ventilated walls with wooden or bamboo studs and grass infill (Figure 4.4.5).

The high-angle roof (60 degrees) is constructed with wooden frames. The rafters and purlins are curved which also result in curved roof cladding (Figures 4.4.6 and 4.5.7). The high gable extends the height of the room for heat convection (Jaijongrak 2000), while the long projection eaves protect the house from heavy monsoon rains. Palm leaves and grass were widely used for cladding the roof.

To ensure proper comfort and ventilation under severe heat and high humidity, the houses are normally oriented toward a North-South direction, to face the wind

which usually comes from a South-Western direction. However, if a house is located along a waterway, its orientation will be toward the water. The front of the house and its terrace also provide a main access to the waterway.

For measuring the change, the size of the archetype in this study is drawn from the *traditional Thai house* in the book written by Jaijongrak (2000). The typical example in Ayutthaya in this book have been widely accepted and used as a reference in many universities in Thailand. Table 4.4.1 shows the areas of the floor plans and enclosed space at the upper level. This enclosed space is divided as a bedroom and a kitchen unit. These areas of the archetype will be used in Section 4.5 and 4.6 for comparing with the areas of the *transforming Thai house* and the *reproduction Thai house*.

Figure 4.4.6 Curved rafters, purlins, and battens

Figure 4.4.7 A high-angle curved roof decorated with bargeboard

The total area of the archetype is very large compare with Thai modern houses. However, enclosed space of the original Thai house is rather small compared to the modern house. For a single family in central Thailand, the area of the enclosed space of the modern house is 170-200 square metres (Puwanan 2004) and a one bedroom unit (with verandah) of the *traditional Thai house* is 40-50 square metres (Jaijongrak 1975). Additionally, Jaijongrak (2002) stated that the area of the terrace is normally more than 40 percent of the upper floor area and increases to more than 60 percent if the verandah is included (see Table 4.4.1). One of the reasons is that the Thai house traditionally contained almost no furniture. Instead, the residents used several reed mats on the floor for sleeping or sitting. The single-family buildings are composed of only a bedroom unit and a kitchen unit. Most of the activities are outside the enclosed space.

Table 4.4.1 Areas of the archetype in Central Thailand

Floor areas (Square metres)				
Total area	**Upper level**	**Ground level** (Earthen floor)	**Enclosed space** (Upper level)	**Verandah** (Upper level)
342	171	171	54 (31.6% of the upper level)	27

4.5 Major changes of the traditional house

This section describes the transformation which has usually occurred to the villages and the *traditional Thai houses* in Ayutthaya. The discussion begins with the modernization in the villages, the change of the settlements and the difference between two locations. Moreover, it indicates the main transformations that have happened in the traditional house. The discussion goes on to the uses of materials at each construction element. The information was derived from around 51 houses in Pakkran and Ladchado (the urban district and rural villages) in 2005.

Before the modernization period, the villages were shaped by the existing topographical features of natural elements such as rivers, canals, and agricultural land, which influenced the settlement patterns. The land throughout the country belonged to

the King. Modernization of Thailand began in the 1850s but the lifestyle of people increasingly changed after the era of the King Rama the Fifth (1910 to 1945) of the *Chakri* dynasty (1768 to present). Chaweewan (2001) proposes the following main reasons relating to the changes in settlement patterns.

1. The land ownership right permitted by King Rama the Fifth meant people could own land.
2. There were the distribution of roads, which provided land communication between the existing settlements or created new settlements; and
3. The work places and the commercial districts had changed from the waterfront areas to the areas along the roads.

The first settlement of Pakkran village is recorded in late 1890s (Sub-district government office in Pakkran district 2005). The traditional houses were arranged as compact clusters among relatives. Many clusters were located along the canal and combined into a linear settlement. The residents began to move or modify their houses to face to the new earth roads in the 1950s. In the 1970s, the first concrete road was constructed close to the village (Interview with the senior officer of Pakkran sub-district offices in 2005). The disconnection of the houses from the canals is also noticeable from the new access in the houses located between the canal and the road. The layout of the new road promoted the expansion of the village behind the linear settlement along the canal. The new houses were arranged along or besides the previous linear settlement and commonly accessible from the road with no relation to the canal.

Ladchado village was established in the late 1700s (Sub-district office in Pakhai district 2005). The arrangements of houses were linear along the main canal and many sub-canals, which made this settlement into a cluster village from the beginning. Different from Pakkran village, many houses were located behind the waterfront houses and did not have access from a road. The residents of these houses gained access from pedestrian ways and used boats when the village was flooded (Interview with the senior officers of Pakhai sub-district office in 2005). In the last thirty years, walk-way bridges made from wood were built. In 1975, the first concrete structures was constructed and extended along the increasing of the number of houses. The residents modified their entrance to relate with these bridges. The construction of concrete road began in 2002 and finished two years later significantly caused the decline of the seasonal flood and the accessibility by cars in some areas.

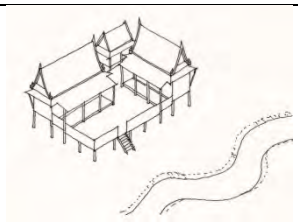
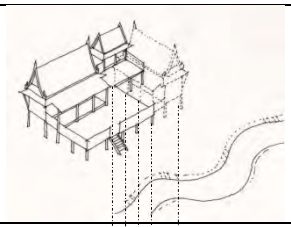
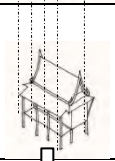
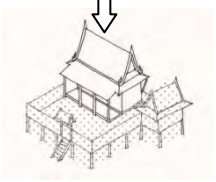
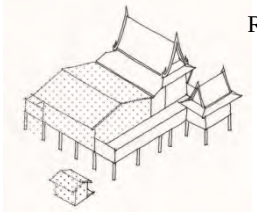
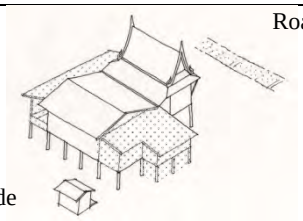
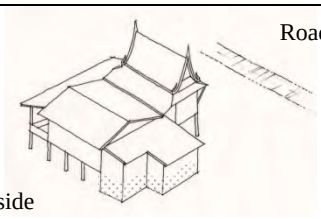
These changes have occurred and related to the building compound. The multi-units of extended families clustered around a central terrace have been transformed to the compact building of a single family. As seen in Figure 4.5.1, the *transforming Thai houses* in both the urban district and rural village appear as individual units. However, these houses still have been grouped together with relatives' houses.

a)

b)

Figure 4.5.1 *Transforming Thai house* as a single-compact house

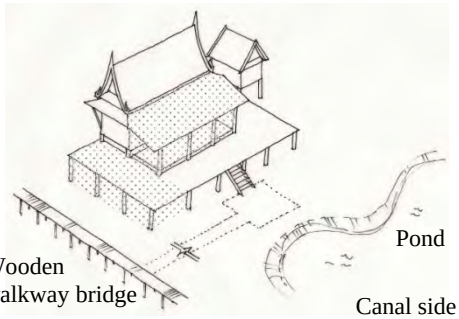
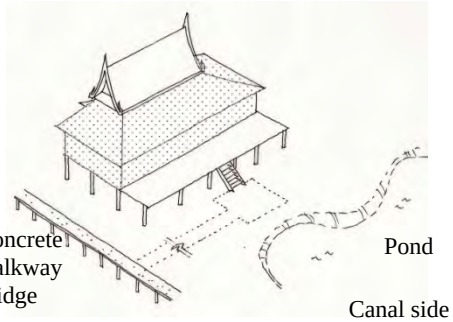
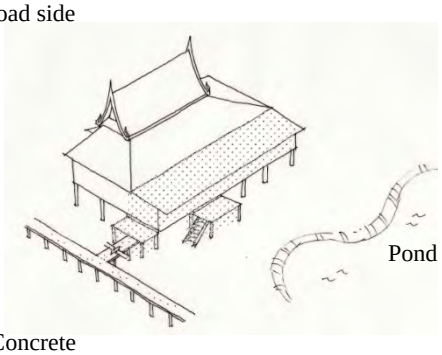
a) In the urban district village b) In the rural village

Traditional Thai House	**Before 1945** -Parent's house in linear settlement along the waterway -Located in front of the canal	 Canal
	1945 -Son got married and traditionally planned to move to bride's land -Dismantled his bedroom unit and transported by waterway to new site	  Transported to new site
	1945 -Reassembled with new kitchen and terrace -In linear settlement but behind the waterfront area - About 100 meters from canal **1950s** - Beginning of transportation by road	 Road side Canal side New site
Transforming Thai house	**1960s** -Built the roof on modified terrace -Built bathroom at the canal side **1975** -Beginning of concrete road, water and power supplies in some areas	 Road side Canal side
	1990s -Disappearance of seasonal flood **1996** -Moved the kitchen unit out -Extended the kitchen and bathroom at upper level	 Road side Canal side
	2001 -Built the storage and bathroom at ground level -House accessibility by concrete road	 Road side Canal side

Source: From the interview of the households in house no. CH-PK-04

Note: The new or extension parts are shaded

Figure 4.5.2 Typical separation and change of the sample in the urban district village from cluster unit to individual unit

Traditional Thai House	**1885** - House constructed -In cluster settlement behind the early linear settlement -About 300 meters from canal -Great fire disaster in the village in 1936	
	1970s -Wooden walkway bridge network in the village **1985** -Extended verandah and terrace	
Transforming Thai house	**1990** - Concrete walkway bridge -Extended roof and built walls for enclosing hall -Combined kitchen to main building -Bathroom located behind the house	
	1992 -Connected entrance to walkway bridge -Moved stair to bridge side **1999** -Built bathroom at the upper floor -Infrastructure with water pipe and electricity **2004** -Road construction causing the disappearance of seasonal flood in some areas	Road side 

Source: From the interview of the households in house no. U-LD-11

Note: The new or extension parts are shaded

Figure 4.5.3 Typical change of the sample in the rural village from cluster unit to individual unit

From Figures 4.5.2 and 4.5.3, the transforming houses, which are modified from the traditional houses, were obtained from two bases: first, the houses were moved from other places; and second, the houses were modified on their original location. These houses were modified and new parts were added. Houses built in the first manner represent the distinctiveness, transportability, of the *traditional Thai house*. The house can be quickly dismantled, assembled or moved from site to site. Even the later houses always are shifted, rotated and adjusted on the original site when needs for change arises.

From extended family system in central Thailand, additional bedroom units were added when the family size increased. The central terrace platform is extendable while living units were added on. Traditionally, son left his family home to join the wife's family. He would remove his bedroom unit from his parents' house and attached it to his wife's home or extend this unit with a new terrace and kitchen unit.

In the *transforming Thai house*, enclosing of the central terrace to the hall provides an extra space for accommodation (see Figure 4.5.4). In addition, the verandah is modified to be part of the hall. The multi-level floor is also adjusted to become one continuous level. Consequently, the most obvious change of the physical feature is at the central terrace which was enclosed by roof and walls. Two main parts which are combined together to be the *transforming Thai house* are: 1. Original part and 2. Modified or extension parts.

The original part still uses wooden posts extending from ground to the roof. In some houses, the wooden pillars underneath the houses have been replaced by concrete columns. There are new types of gable which differ by the shape and angle of the roofs. The first type with medium angle (30-45 degrees) is assumed to be developed from the original shape (Figure 4.5.5). The second type with low angle (10-20 degrees) is an adaptation from the bungalow-style roof (Figure 4.5.6). Both shapes cover longer column span and reduce the height of the ridge. The first type may be considered as a traditional roof if the materials and the structure are the same as the roof of the archetype.

Roofing materials have changed from grass to cement tiles, corrugated metal sheets or corrugated cement tiles. Some of the wall panels remain the same as the original but some have been changed to a corrugated metal sheet or a wood weather board (see Figures 4.5.7). A cement board, which is a combination of cement and fibers, is occasionally found. It is used without plaster in the surveyed sites. A cement

board with asbestos fiber has been gradually replaced by a non-asbestos cement board or a corrugated metal sheet.

(a) (b)

Figure 4.5.4 Interior space and outside appearance of a hall

(a) (b)

Figure 4.5.5 A medium angle roof of a transforming Thai house

(a) (b)

Figure 4.5.6 A low angle roof of a transforming Thai house

(a) (b)

Figure 4.5.7 Walls in the rural village

(a) Corrugated metal panels (b) Wood weather boards

Table 4.5.1 shows the beginning of the houses in the urban district and rural villages. Most of the samples in the urban district village have been transformed from the relocated traditional houses. These houses were initially built at other sites and had been moved to the current sites. In the rural village, most of the houses have been constructed from the beginning and transformed at the current site. In contrast to the transformations which started from the traditional houses, a small number of the *transforming Thai house*s have been newly built. The traditional unit and the other parts have not transformed but were combined and built for creating the appearance of the *transforming Thai house*.

Table 4.5.1 Three types of the beginning of the transforming houses

Beginning of the transforming houses (Size in Square metres)			
	The house with traditional unit built on current site	**The house with relocated traditional unit**	**The house with a mix of traditional unit and modern part at the beginning**
Urban district village	6	11	4
Rural village	22	6	2

Table 4.5.2 shows the areas of the transforming house and the remaining of the traditional house. The houses in the rural village are larger than in the urban

district village. A plenty of land in rural area received more extensions. The areas and plans of the house in the urban district village are compact but slightly bigger than the archetype. Interestingly, the area at the ground level is more than the upper level, which shows the permanent uses at the ground level. A kitchen, a bathroom and storage are sometimes found at this level. The areas of the remaining of the traditional house in both villages are almost identical. However, the larger house in the rural village reduces the proportion of the appearance of the traditional house.

Table 4.5.2 The area of the transforming house and the remaining of the traditional house

Averaged areas of the transforming house (Square meters)					
	Total area	**SD**	**Upper level**	**Ground level**	**Remaining of Traditional house** (upper level)
Archetype	342	-	171	171 (Earthen floor)	171 (100%)
Urban district village	312.8	95.1	150.7	162.1 (Earthen/Concrete floor)	38.8 (25.7%)
Rural village	406.2	131.3	203.2	204 (Earthen floor)	41.2 (20.3%)

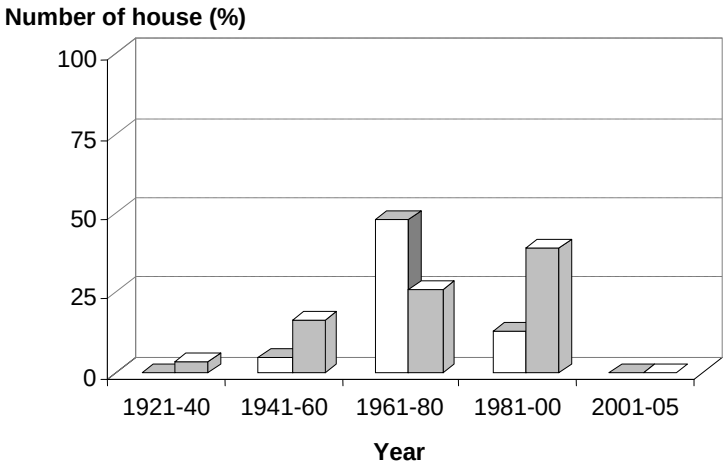
Table 4.5.3 The area of the enclosed space at the upper level

Areas of the enclosed space at the upper level (square meters)				
	Upper level area	**SD**	**Enclosed space (Upper level)**	**Percent**
Archetype	171	-	54	31.6%
Urban district village	150.7	45.6	135.5	89.9%
Rural village	203.2	63.9	188.6	92.8%

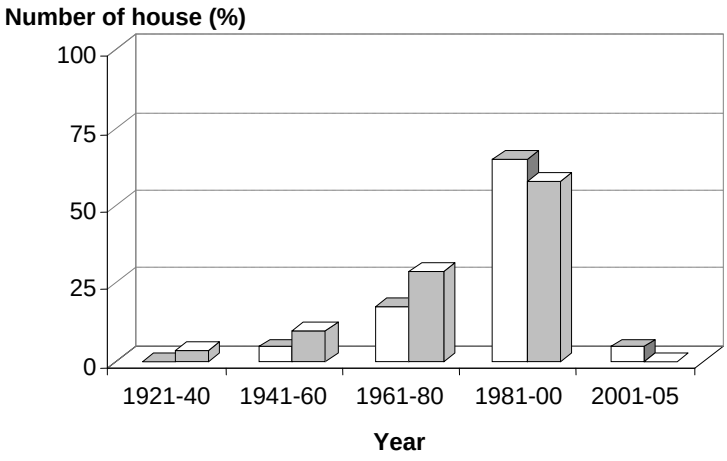
Table 4.5.3 shows that the archetype and the houses in the urban district village are almost the same size. However, the enclosed space, which is composed of a bedroom unit and a kitchen unit, is much smaller than in the urban district village.

The only space which can be classified as semi-open space is a porch. It explains that the transforming house contains a much larger interior space compared with the archetype.

The *traditional Thai houses* were gradually modified until they were merged to be part of the transforming houses. Because of later developments, the highest number of modifications in the urban district village occurred earlier than in Ladchado (see Figure 4.5.8 (a)).



a) Beginnings of modification



b) Beginnings of extension

Figure 4.5.8 The numbers of houses beginning to be modified and extended

In the urban district village, the numbers of the first modification of the traditional houses were highest during the 1960s and 1970s. In the rural village, the number of the first modification of the traditional houses was highest during the 1980s and 1990s. The beginnings of the modification were obviously related to the time that the roads were constructed in 1975 in the urban district village and 1985 in the rural village.

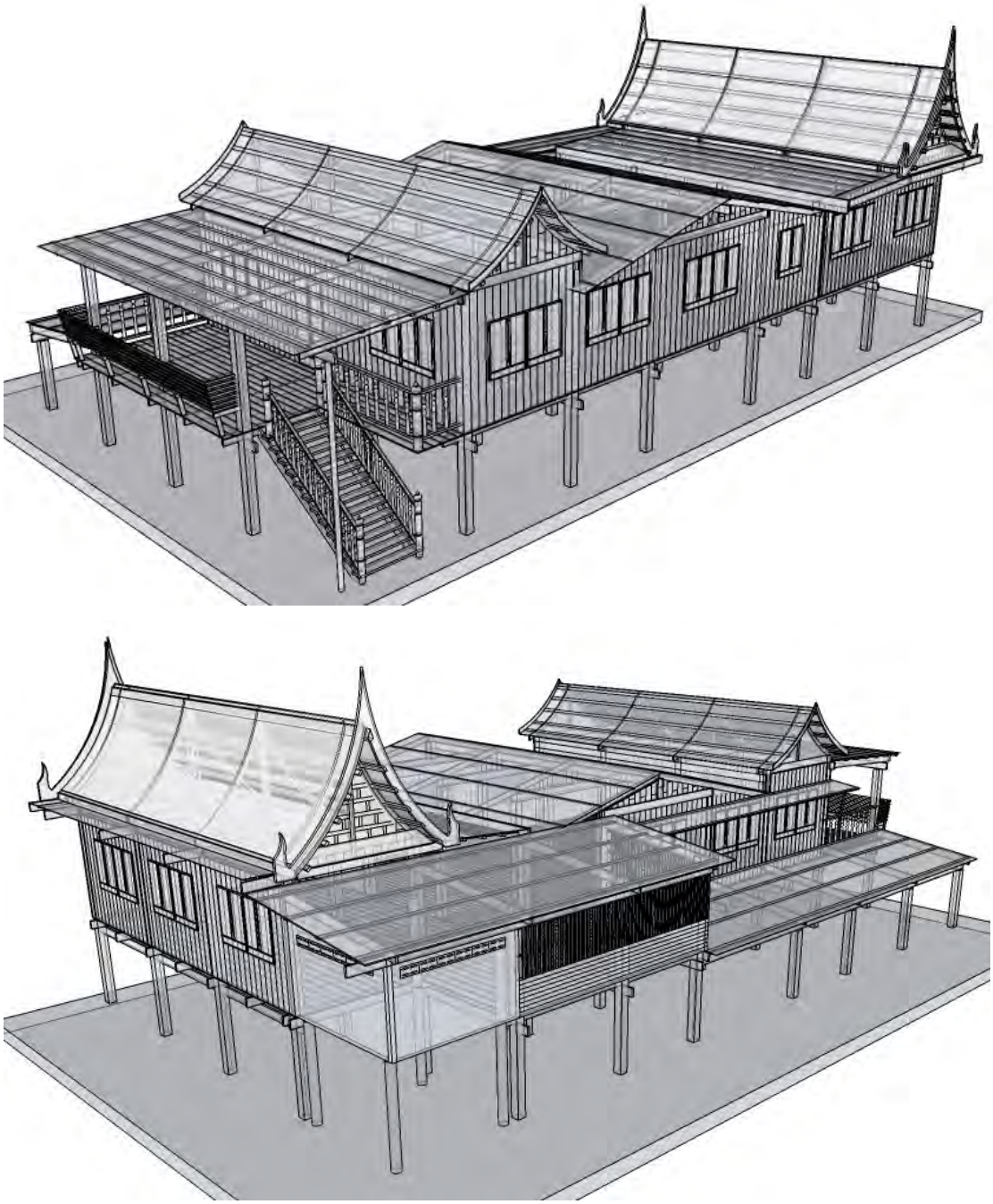
Concerning the extension, the houses in the rural village were extended and declined earlier than in the urban district village (see Figure 4.5.8 (b)). According to interviews in the rural village, there was a big fire in 1938 in which a hundred traditional houses were destroyed.

This event resulted in many new constructions in the damaged area which could not retain the traditional style because of the scarcity of timber. The bungalow style, which was imitated from the houses in the capital, was considered to be more economical and was efficiently applied to the extension of the traditional houses. While the developments of the extension in the rural village were influenced by the big fire, the developments in the urban district village were still related to transportation development and clearly showed during the 1980s and 1990s.

4.5.1 Construction elements in major changes

As explained earlier, the archetype of the *transforming Thai house* is the *traditional Thai house*, adapted by adding new construction to and merging of the original parts (see Figures 4.5.9 and 4.5.10). This sub-section is presented to clarify the physical appearances of the construction elements in the transforming house. Five major changes are found in the surveyed villages. The materials and construction methods will be discussed in Chapter 5.

The discussion is based on the data from interviews with the households and a survey in 2005. Table 4.5.4 compares the average areas of the main spaces of the archetype and the major transformations of the transforming houses in Pakkran and Ladchado villages. Accepted as a typical example of the *traditional Thai house* in Ayutthaya, the house defined by Jaijongrak (2000) provides the size of the archetype. These areas are used for the discussions in each major change.

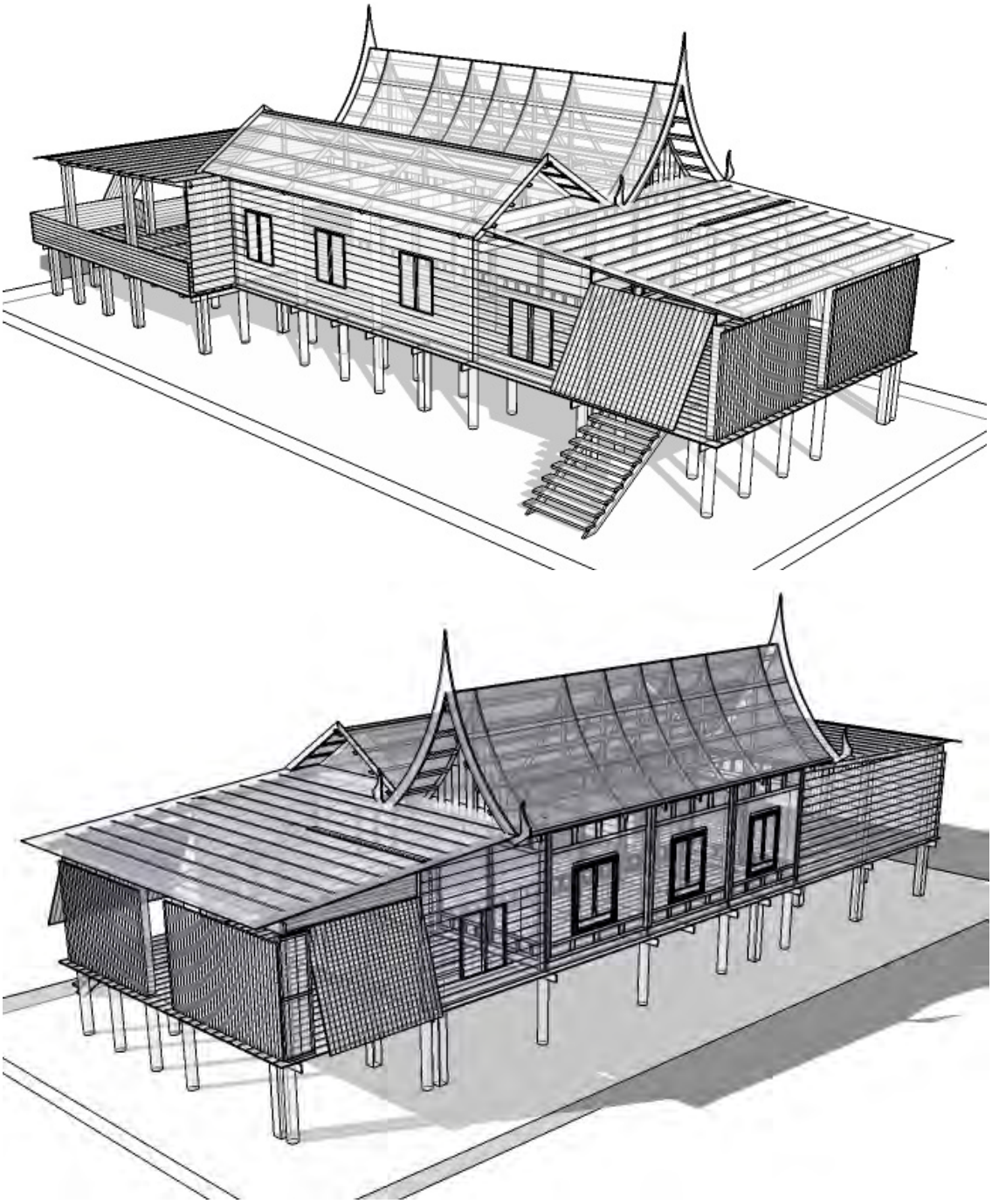


Source: House no. P-PK-02

Note: Beam, wall and floor at ground level are new elements comparing with the archetype.

Remark: Illustrated only at some parts of the house.

Figure 4.5.9 Construction elements of the transforming Thai house in the urban district village



Source: House no. U-LD-06

Note: Beam, wall and floor at ground level are new elements comparing with the archetype.

Remark: Illustrated only at some parts of the house.

Figure 4.5.10 Construction elements of the transforming Thai house in the rural village

Table 4.5.4 The areas of the major changes in the urban district and rural villages

	Central terrace (Upper fl.)	**Enclosed space** (Ground fl.)	**Verandah** (Upper fl.)	**Toilet** (Upper fl.)	**Kitchen** (Upper fl.)
Archetype	90 (52.6%)	0 (0%)	27 (15.8%)	0 (0%)	18 (10.5%)
	Central hall (Upper fl.)	**Enclosed space** (Ground fl.)	**Porch** (Upper fl.)	**Toilet** (Upper fl.)	**Cooking area** (Upper fl.)
In the urban district village	80.2 (53.2%)	20.5 (13.6%)	12.2 (8.1%)	4.5 (3%)	10.7 (7.1%)
In the rural village	89.5 (44%)	0.5 (0.3%)	14 (6.9%)	4.1 (2%)	14.2 (7%)

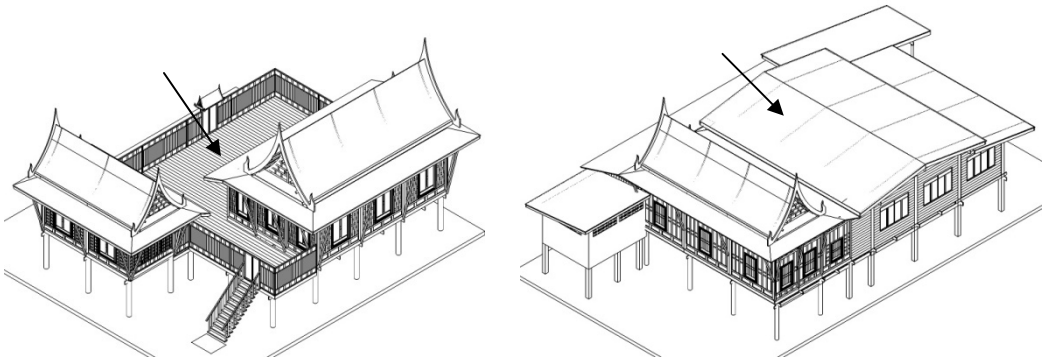
The significant changes are arranged in order of areas or uses in the previous section. The parts which are directly related to the discussion are the central terrace, the area under the raised floor, the verandah, the bathroom, and the food preparation area. Since there are no new constructions for eating and sleeping areas, the discussion of the modification for these two areas is combined with the others.

4.5.2 Central terrace to hall / Multi-level to flat floor

Central terrace to hall

Enclosing the terrace to form a central hall has been the most substantial change of the *transforming Thai house*. The terrace is the largest single area of the *traditional Thai house*. It forms the centre of house units and functions as a linkage or bridge, because it was necessary to cross the terrace to get from one unit to another (see Figure 4.5.11). Some parts of the central hall were newly constructed or re-constructed with the materials taken from the central terrace to a more compact shape. However, the areas of the central hall are similar to the area of the central terrace (see Table 4.5.4).

The interviews with the residents in both villages revealed many reasons for enclosing the central terrace. First was the consideration to protect the wooden floors exposed to the sun and the rain because of the lack of timber for replacement in the later period.



Source: P-PK-01 and the traditional Thai house drawn from data by Jaijongrak, 2000

Figure 4.5.11 Central terrace of the traditional Thai house and main hall of the transforming Thai house

Figure 4.5.12 shows the number of houses in which the central terraces were enclosed and had been constructed during the last six decades. This shows that before the coming of the road in the urban district village in 1973, few houses appeared with the central hall. The second reason for enclosing the central terrace was that many of the interviewed villagers in the urban district village, villagers felt insecure, particularly from strangers who accessed the village by road. They said that there were increasing cases of threat from thieves and burglars.

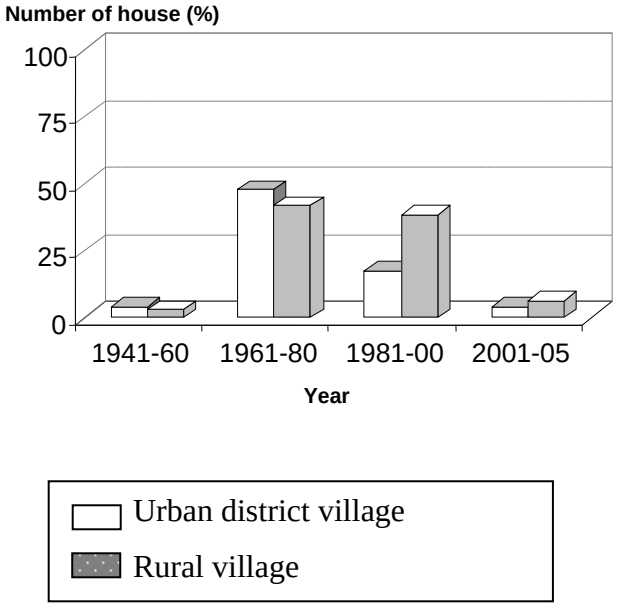


Figure 4.5.12 The number of the transforming houses in which a central terrace was enclosed and multi-level floor was changed to flat floor in the last six decades.

In the rural village, the first road constructed in 1985 did not relate to the beginning of the enclosing of the central terrace. Many houses already appeared with the central hall from the 1960s to the 1980s. The beginning of the walkway bridge, elevated more than two meters above the ground level, is in 1970. Although the users of the walkway bridges were not strangers, the privacy of the space in the central terrace, which was in the same level, was reduced.

Some residents explain that the higher density of houses in both villages relate to the closing of the central terrace. In the past, only relatives built houses in their cluster and always left a distance from the other clusters (Piromya 2000). When the number of households increased, there were more chances of building houses attaching to the houses of other families. So the residents need more privacy from the central terrace after these developments.

The last reason results from the additional function in this space. From the survey inside the houses, they appear to have some furniture and mattresses. Some residents stated that a change of life style required more interior space and some spoke about the increasing size of families in a limited space. Land becomes expensive after the coming of roads and other infrastructures.

The furniture is usually movable such as cabinets, tables, chairs, cupboards and drawers. The mattress is folded and kept from visibility. However, most of the transforming houses contain only a small amount of furniture compared with the contemporary house. The furniture is arranged to attach to the walls for keeping an open space in the central hall. The interior space of the central hall has to receive more activities than the central terrace.

Considering the process of enclosing, some houses, mostly built in the last decade and in the urban district village, have been built with a central hall from the beginning. Six houses of this type were found from the samples (see Appendixes B). This shows the acceptance of the *transforming Thai house* from the residents in the urban district village.

From Table 4.5.4, the area of the central hall in the rural village is larger than in the urban district village and the central terrace of the archetype. However, the percentage of this space and the upper level in the rural village are less than in the urban district village and the archetype. This means that the size of the house in the rural village increased but maintained the area of the central terrace.

(a) (b)

Figure 4.5.13 A *bungalow* roof in the rural village

(a) (b)

Figure 4.5.14 A *hip* roof in the rural village

The central hall is composed of three main constructive elements: roof, floor and wall. Three types of roof covering have been surveyed: low-angle *bungalow*, *hip* (Figures 4.5.13 and 4.5.14) and medium-angle *gable* roof style. The *bungalow* roof is most widely used probably because its properties can cover a wide span of terrace. Another reason is the residents' habit which tries to copy the styles of real estate development in urban areas.

Wall panels can be classified into two types: semi-enclosing and entirely enclosing panels (see Figures 4.5.15). Some entirely enclosing panels can be pushed up to open and close as a partial wall or an entire wall. The panels, hinged at the top, provide function like eaves when they are opened. The results of changing terrace to a central hall are large internal space, new circulation and the decline of the multi-unit house.

(a) (b)

Figure 4.5.15 Walls in the rural village

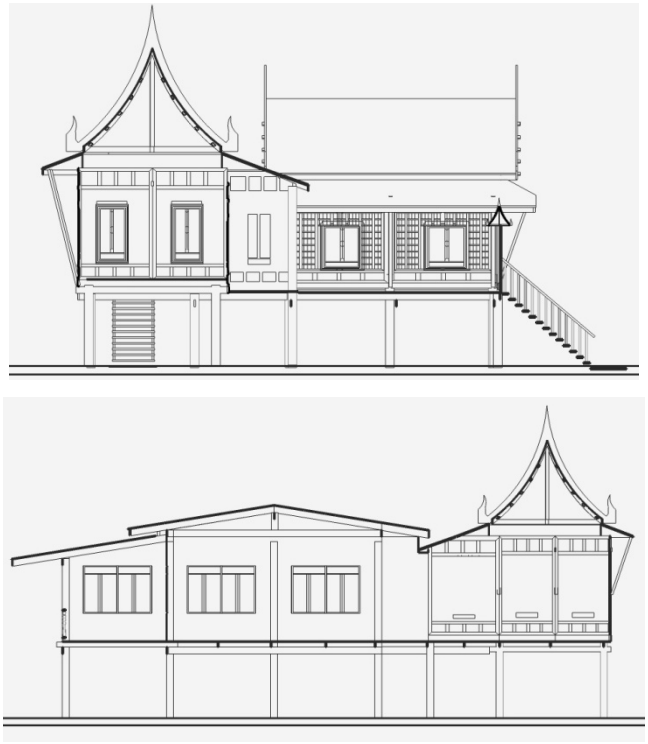
(a) Semi-enclosing panels (b) Enclosing wall panels with push-up window panels

Multi-level floor to flat floor

This transformation usually occurred at the same time as the enclosing of the central terrace. In the past, the floors of the *traditional Thai house* were divided into three main steps. The terrace floor was the lowest, the verandah floor was the middle and the bedroom unit floor was the highest level (see Figure 4.5.16). Each platform was lifted up about 30-50 centimeters. The gaps between levels were left open for drainage from the central terrace and for passing of ventilation underneath the house through the upper level. Another function of the step was for sitting when there was no use of furniture in Thai tradition.

In the *transforming Thai house*, multi-level floors are usually leveled to a flat floor at the same time as a central terrace was enclosed to be a hall (see Figure 4.5.11). This adjustment of levels has occurred both in the traditional and new structures. The residents stated that the main reason is the need of an entirely enclosed space in the central hall for security as described previously. The opening of a multi-level floor can be entered by thief or burglar (In a few transforming houses that retain steps, the gaps were closed for this reason). Some residents explained that there is no need for drainage of rain on the floor because of the new roof over the central space. The introduction of furniture and the modern life style are amongst the main causes.

This adjustment, merging a verandah to a central terrace area, creates the large interior space with various activities. The disadvantage is an absence of ventilation from underneath the house.

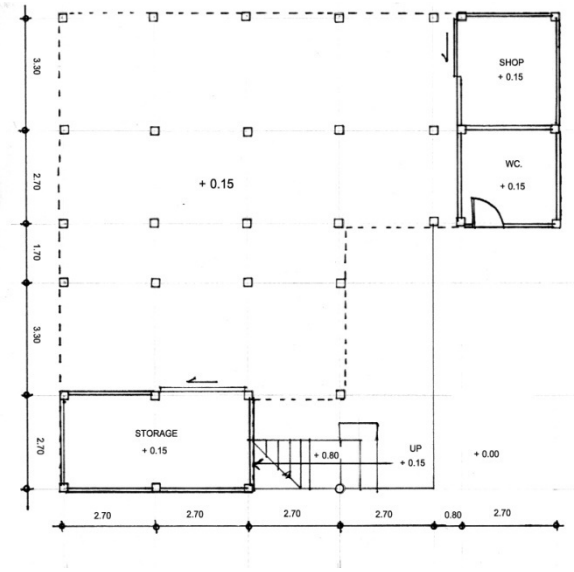


Source: P-PK-01 and the traditional Thai house drawn from data by Jaijongrak, 2000

Figure 4.5.16 Multi-level and flat floors

4.5.3 Changes of the area under a raised dwelling

From Table 4.5.4, this change has obviously occurred only in the urban district village (Figure 4.5.17). The residents in the urban district village said that the absence of flooding in some years since the 1970s and complete disappearance since 1996 make the possibility of building a room at the ground level. Only a few houses in the rural village have a room at the ground floor. Similar to the urban district village, the construction of roads in 2004 caused an absence of flooding in some areas. Some residents in the rural village explained that they plan to build a room at the ground level if flooding disappears. Figure 4.5.18 shows that the emerging of the road in the urban district village relates to the occurrences of an enclosed space at the ground level.



Source: House no. U-PK-05

Figure 4.5.17 Rooms and concrete floor at ground level of the transforming house

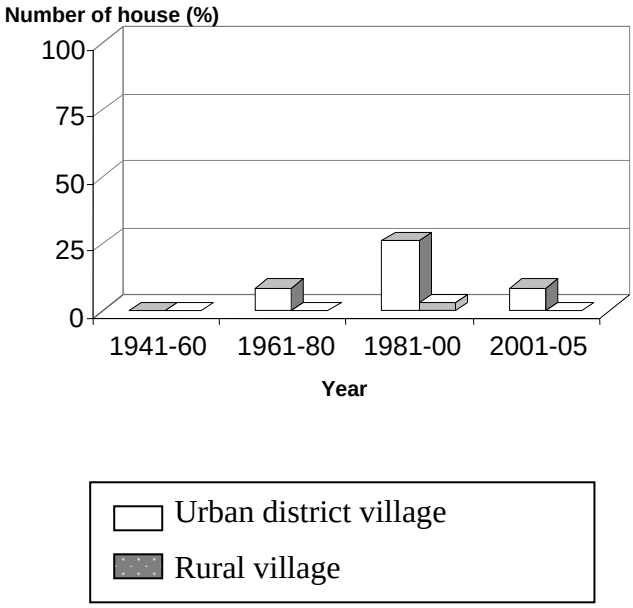


Figure 4.5.18 The number of the beginnings of an enclosed space at the ground level of the transforming houses in the last six decades

The residents stated that the other reasons for change are the shortage of land and the increasing of family size. The floor of the *traditional Thai house* at ground level is an earthen surface. The use of concrete to cover the earthen surface is

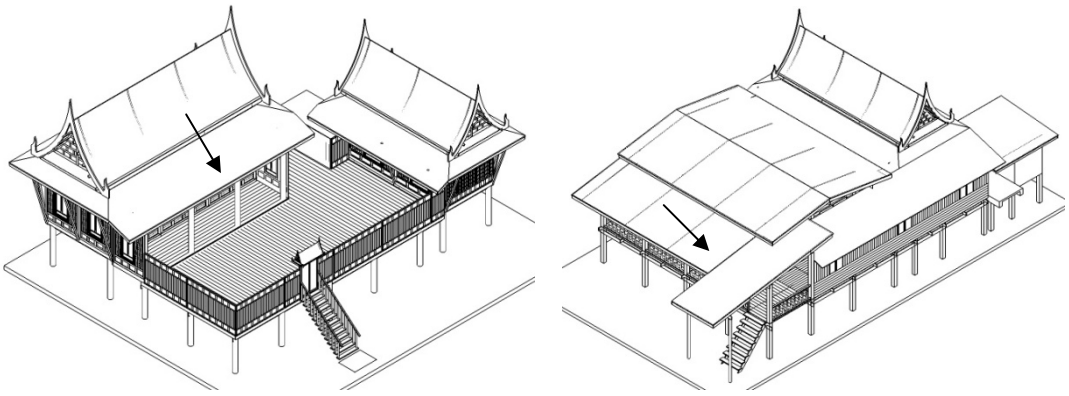
widespread. In some cases, the surface is covered with ceramic tiles. The residents still use this area for various purposes including as parking space (see Figure 4.5.19). The enclosed space is usually used as a bedroom, a kitchen, and a store room (see Figure 4.5.20).

Figure 4.5.19 Concrete covered and earthen floor for multipurpose space

Figure 4.5.20 Enclosed space at ground level

4.5.4 Disappearance of a verandah and erection of a porch at front

The original verandah is covered with a long eave and is enclosed by three panels to form a platform facing the terrace. From the terrace, it has a function as transitional space before residents enter to the bedroom. Because the terrace is transformed to the central hall, a verandah which is attached to the terrace and the bedroom unit is also transformed to become part of a central hall (see Figures 4.5.21 and 22).



Source: P-PK-01 and the traditional Thai house drawn from data by Jaijongrak, 2000

Figure 4.5.21 A verandah of the traditional Thai house and a porch at the transforming Thai house

The verandahs of the archetype are both at the bedroom unit and kitchen unit, resulting in the larger area than a porch. Similar to a verandah, a porch is constructed for providing a transitional space in the *transforming Thai house* (see Figure 4.5.23). It is at the front of the house facing the roadside instead of the central terrace in the *traditional Thai house*. The most common type of porch is constructed as a separate structure from the house. Its size depends on the house and column span. The *lean-to* roof is the most widely used for the porch. The porch is usually found with bench and connected to ground level with the staircase or ladder. The area of a porch is less than half of the area of a verandah in the archetype (Table 4.5.4).

(a) (b)

Figure 4.5.22 Both a terrace and a verandah rarely remain in vernacular villages.

Figure 4.5.24 shows the period of the erection of a porch at the front of the transforming houses. In both villages, the erection began at the same time but was

found more in the urban district village during the early period. The residents stated that the late erection of the porch came from the construction of the walkway bridge in the 1970s. Because the bridge was sometimes constructed at the side of the houses, the house could be entered directly at the upper level at the central hall. After that period, the residents began to build the porch and changed the entrance to improve privacy and security.

(a) (b) (c)

Figure 4.5.23 A porch with a *lean-to* roof, a bench and a stair

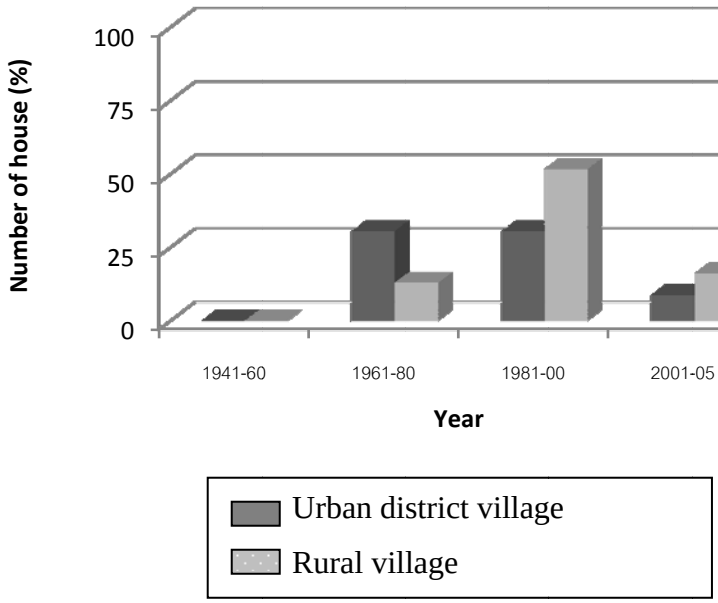
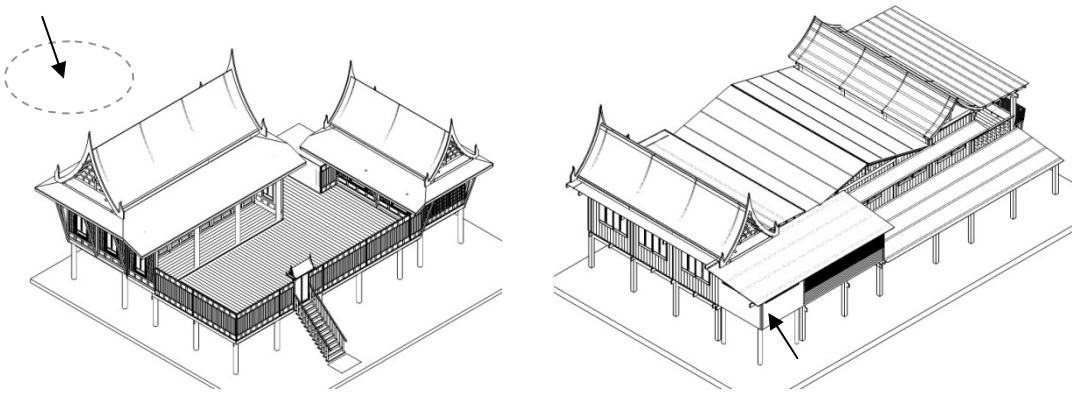


Figure 4.5.24 The number of the beginnings of a porch at the transforming houses in the last six decades

4.5.5 Bathroom at the upper level

In the past, the residents excreted in the jungle around their houses. They took a bath in canals or carried water from natural sources to bathe in the space underneath their dwellings. According to information from the public service officer, external bathrooms have been introduced to the village since the 1960s.



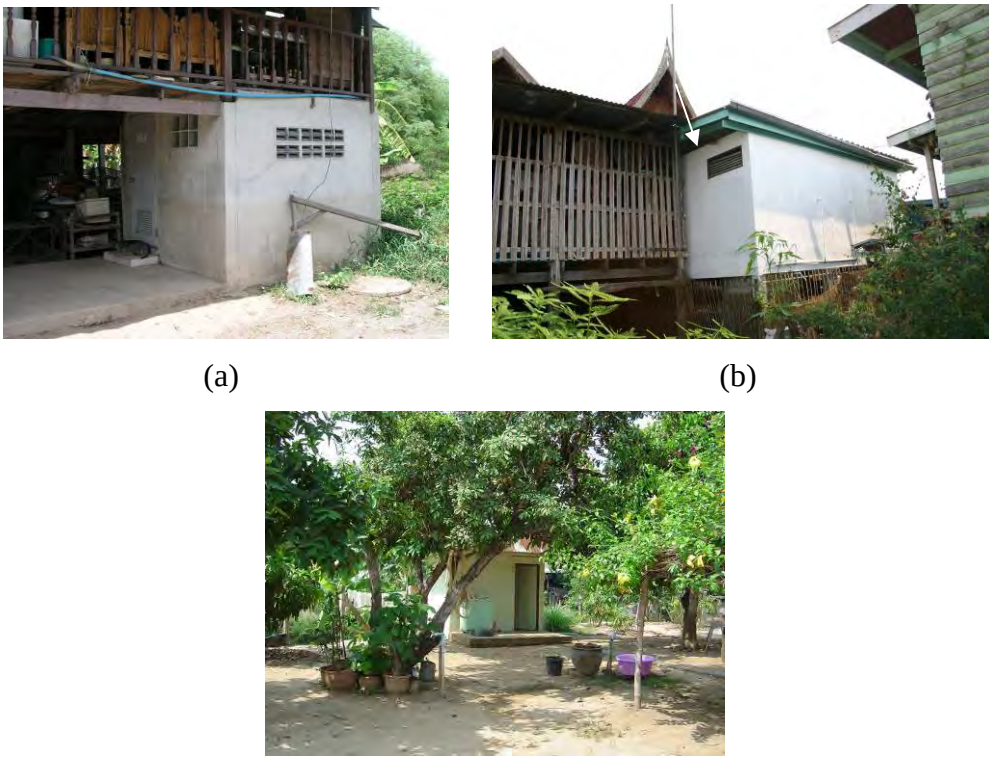
Source: P-PK-02 and the traditional Thai house drawn from data by Jaijongrak, 2000

Figure 4.5.25 Bathroom at the back and upper level of the house

At first, bathrooms at ground level were recommended by the public health service staff. Later, they have been built on the upper level because of the need of convenience and privacy. Nowadays, the bathrooms are usually found on the upper floor, at the space underneath the houses or at the back of the dwelling (see Figure 4.5.25). The internal bathrooms are always located at the corner of the expansion part of the house. These bathrooms are typically kept separate from the traditional Thai structures (see Figure 4.5.26).

From Table 4.5.4, the areas of the bathroom in both villages are similar. The larger houses in the rural village result in a low percentage. Figure 4.5.27 shows the number of houses with a bathroom at the upper level during the last six decades. Some houses in the urban district village do not have a bathroom at the upper floor but they are found at the ground level. The construction of the bathroom in both villages mostly began in 1980s but was found more popular in the rural village. The residents in the rural village stated that the bathroom at the upper level was necessary and previously temporarily built because of the periodic flooding. They began to permanently merge a bathroom to their houses in the 1980s after the emerging of a

central hall. The other reasons stated by the residents in both villages are the security and privacy.



(a) (b)

(c)

Figure 4.5.26 Bathrooms at the ground level, upper level, and back of the house

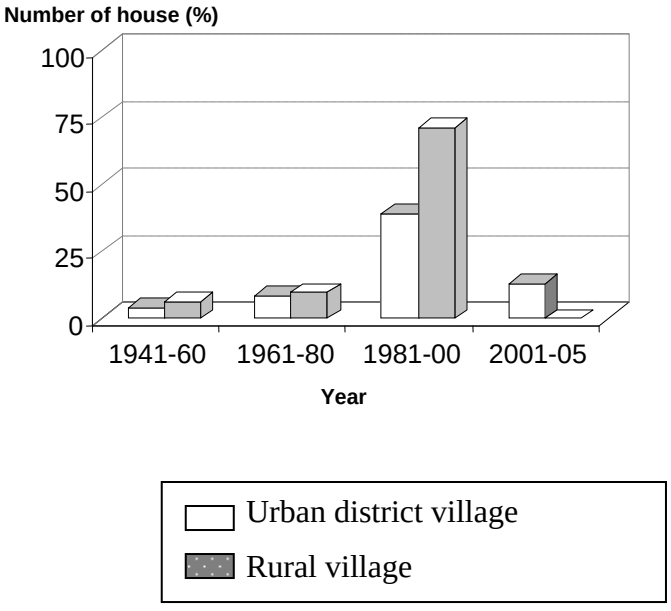
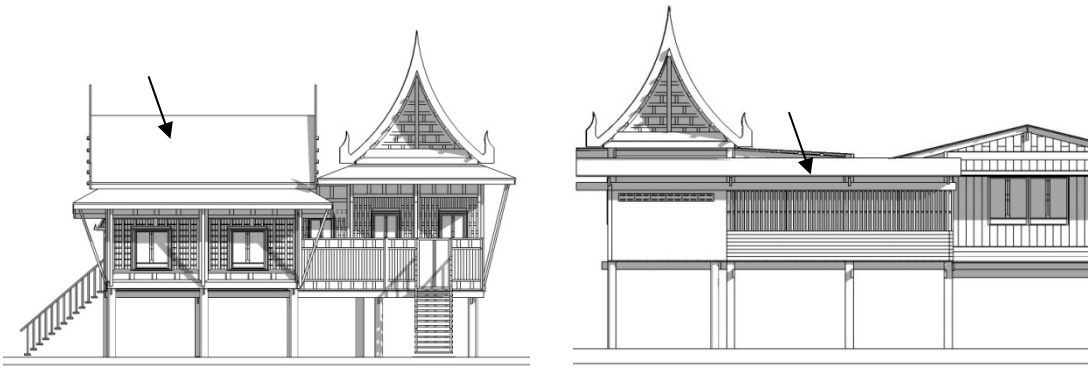


Figure 4.5.27 The number of the beginnings of a bathroom at the upper level of the transforming houses in the last six decades

4.5.6 Kitchen unit to cooking space

The interviewees indicated many reasons for the disappearance of the kitchen unit. Firstly, the cooking unit was made from less durable materials compared to the bedroom unit. Secondly, the kitchen units were converted to a bedroom unit. Thirdly, the land plot of the dwelling was divided into smaller and narrower units. So, it was difficult to locate the kitchen unit at the corner of the house. Fourthly, some houses were dismantled, relocated and assembled without kitchen units. Therefore, the builders built a cooking space inside the house to replace a separated kitchen unit (Figure 4.5.28).

The areas of the cooking space in both villages are smaller than the kitchen unit in the archetype (Table 4.5.4). Figure 4.5.29 shows the number of houses with a cooking space at the upper level during the last six decades. Similar to a bathroom, some cooking space is found at the ground level in the urban district village. The construction of the bathroom at the upper level was found to be more popular in the rural village. The residents in the rural village explained that the kitchen or cooking space have to be built at the upper level because of flooding. The reasons for the residents in both villages for merging of the kitchen are smaller land area, convenience and availability of inflammable roofing materials.



Source: P-PK-02 and the traditional Thai house drawn from data by Jaijongrak, 2000

Figure 4.5.28 Kitchen unit as a cooking space in the transforming house

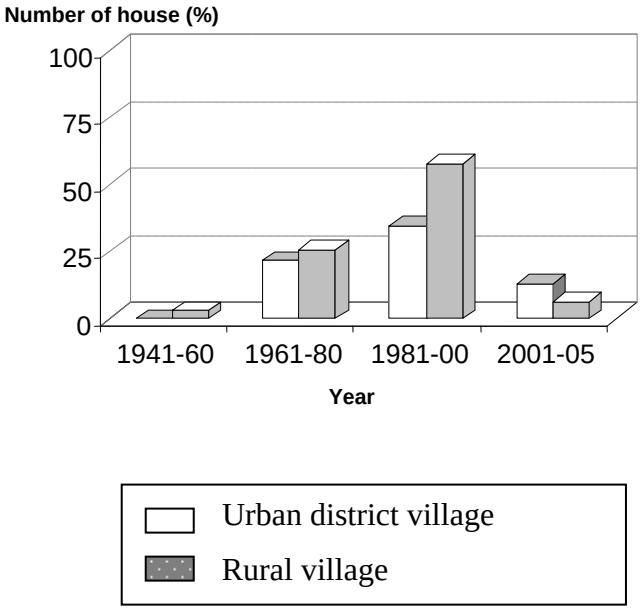


Figure 4.5.29 The number of the beginnings of the cooking space at the upper floor of the transforming houses in the last six decades

(a) (b)

Figure 4.5.30 Semi-enclosed kitchen (a) Wood studs with small gap (b) Combination of wood-stud and push-up panels

The cooking parts are constructed and usually located at the corner of the house for ventilation. This part can be built inside the house or as an extension part of the house. There are four types of kitchen or cooking part in the *transforming Thai houses*:

-Original cooking units are found in a few houses.

-The in-house cooking spaces are built with push-up panel. Some panels in this space can be opened and function like a large window.

-The in-house cooking spaces are built with semi-enclosed panels for ventilation purpose. The ventilated panel is wood stud with small gap. This type of space is sometimes mixed with push-up panel (see Figure 4.5.30).

-The small terrace for cooking with or without handrails and balustrades instead of panels. Materials of the terrace construction are concrete or wood. It is built on a cantilever floor in some samples. This terrace is always combined with the in-house cooking part (see Figure 4.5.31).

(a) (b)

Figure 4.5.31 Small cooking terraces
(a) Concrete structure (b) Wood structure

4.6 Reproduction in the motorway buffer area

Reproduction Thai houses which have been sited along the highway in the Bangpahun area, the buffer area along Phaholyotin Road, have developed since the 1970s (Sub-district office 2005). These houses appeared as single houses similar to the *transforming Thai house* (Figures 4.6.1 and 4.6.2). However, there are many different factors between them:

1. They had not developed from the old *traditional Thai house* but were built with the purpose to have some appearances of the traditional house;
2. The entire building was newly constructed, including both the modern style and traditional style parts;
3. Most of the modern appearances are limited at the ground level; and
4. The materials are as up-to-date as the contemporary house in housing projects.

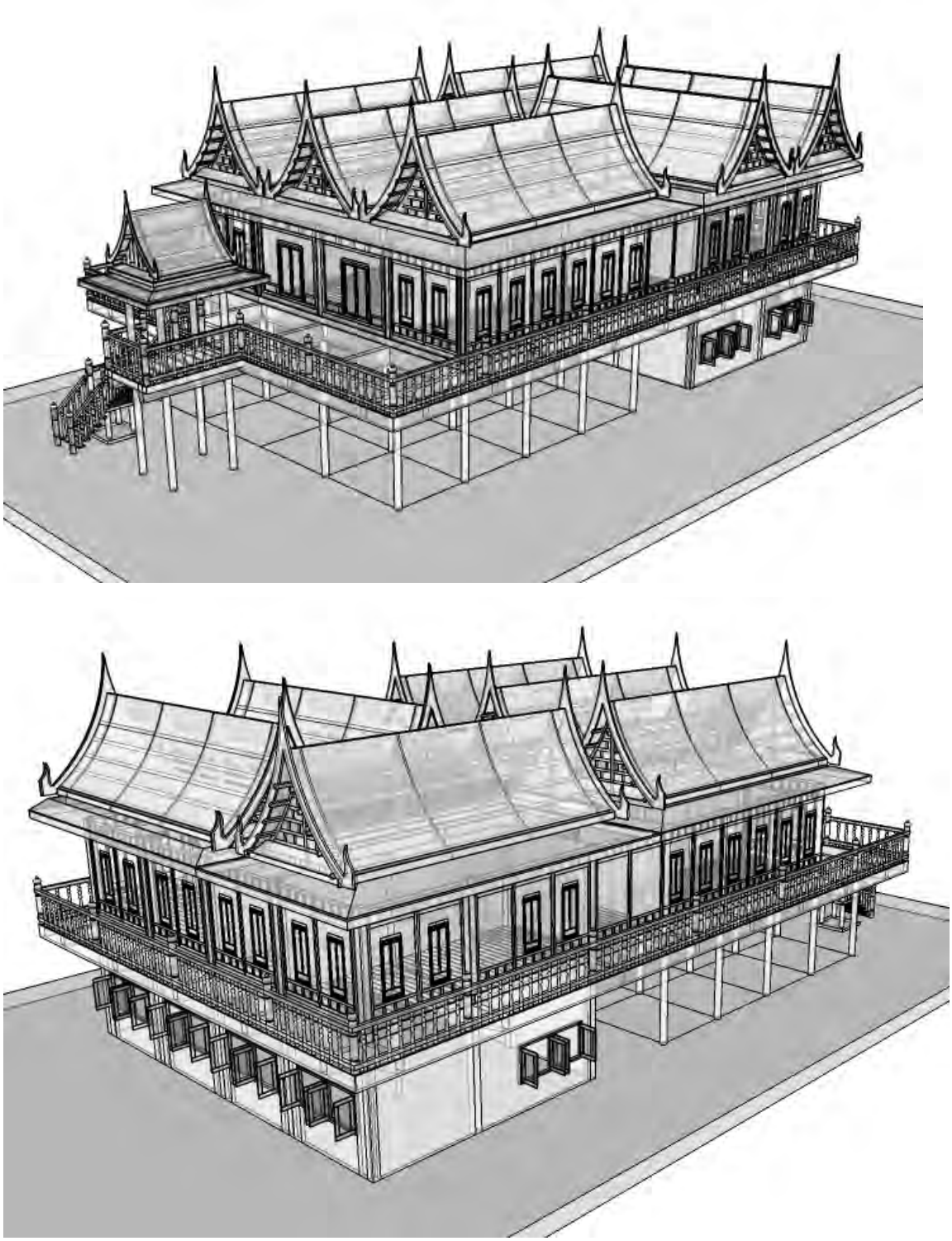
These houses could be ordered to be built at any site by the customers who are often not the people in Ayutthaya. The information was obtained from eight houses in Bangpahun area in 2005. These individual houses were constructed by local builders who used to build the original *traditional Thai house*. Most of the houses in this research belong to the builders and are located close to the builder's workshop. Some of the houses could be shown to customers as examples of the production.

Table 4.6.1 shows the areas of the *reproduction Thai house* and the remaining of the *traditional Thai house*. The reproduction houses are approximately two times larger than the archetype and the transforming houses. They are also larger than the typical houses built by the housing developers, which are 150-200 square metres (Puwanun 2004). One of the reasons for the size is related to the meaning of the vernacular house which is used to express the status of the house owner (Vellinga 2006). As indicated by the interviews, these residents have high status in the local village and have a high income from their house construction business.

The *reproduction Thai houses* are built from the fundamentals of traditional houses and contemporary houses but developed for modern life and available materials. The groups of builders are divided into traditional carpenters and modern builders. Since the forest protection laws, the traditional materials were not obtained from Thai forests but other sources such as the imported timber from neighboring countries.

Table 4.6.1 Comparison of the areas of the *reproduction Thai house* and the remaining of the *traditional Thai house*

	Total area	SD	Upper level	Ground level	Remaining of Thai house at upper level
Archetype	342	-	171	171	171 (100%)
Transforming houses in two villages	367.7	125.6	181.3	186.4	40 (22%)
Reproduction houses in buffer area	587.4	68.1	281.7	305.7	-



Source: House no. CH-BH-12

Note: Beam, wall and floor at ground level are new elements comparing with the archetype.

Remark: Illustrated only at some parts of the house.

Figure 4.6.1 The reproduction Thai house and construction elements

These houses were influenced by the western style house and break many sets of traditional rules. For instance, they are not grouped in the traditional way but are attached to form a large living space (see Figure 4.6.2). At the upper level, most of them have a roofless porch at front and are able to access with an external stair. However, an internal stair is the one that is normally used by a resident. Narrow-shape terraces around the upper level buildings were found in some houses (see Figure 4.6.3). A small area of porch, which is covered with traditional-style roof, connected with the external stair for providing a transitional space, which is similar to a porch of the *transforming Thai house* (see Figure 4.6.4). The obvious features of the house are the wood building with several traditional roofs at the upper level and modern construction at the ground level.

(a) (b)

Figure 4.6.2 Front and side views of a reproduction Thai house

(a) (b)

Figure 4.6.3 A porch at front and a narrow-shape terrace at side of a reproduction Thai house

(a) (b)

Figure 4.6.4 A porch with a traditional-style roof providing transitional space between outside of the house and a roofless porch

Table 4.6.2 shows the enclosed space of the reproduction house at the upper level is as high as the one of the transforming house. Compared with the archetype, the enclosed space is three times larger. However, the residents stated that the use of the enclosed space at the upper level is less than at the ground level. The only function is for sleeping inside the bedroom. There are no multi-activities in the central hall at the upper level.

The whole upper part still uses timber with various methods. Some traditional methods are the same as the original but some are adapted for modern-day tools or for merging with concrete structures at the lower part (see Figure 4.6.5). The wall panels are the same as the original but there are no ventilated panels. This upper part can be accessed both from the stairs inside and outside the house. The plan is different from the traditional style. The living room at this level has functions similar to the central terrace of the *traditional Thai house*.

The ground level part is similar to the contemporary houses built by housing estate developers. Materials are mainly concrete and brick. This part is enclosed for the main living area, bathroom and kitchen. The main entrance leads to the main living room for receiving guests and family living. There are the extensive uses of air conditioners at both levels (see Figure 4.6.6).

Table 4.6.2 Comparison of the areas of the enclosed space at the upper level in a reproduction house

	Upper level area	**SD**	**Enclosed space (Upper level)**	**Percent**
Archetype	171	-	54	31.6%
Transforming house in two villages	181.3	62.3	164.1	90.5%
Buffer area	281.7	53	249.3	88.5%

Table 4.6.3 Comparison of the areas of the major spaces in the *reproduction Thai houses*

	Central terrace (Upper fl.)	**Enclosed space** (Ground fl.)	**Verandah** (Upper fl.)	**Toilet** (Upper fl.)	**Kitchen** (Upper fl.)
Archetype	90 (52.6%)	0 (0%)	27 (15.8%)	0 (0%)	18 (10.5%)
	Central hall (Upper fl.)	**Enclosed space** (Ground fl.)	**Porch** (Upper fl.)	**Toilet** (Upper fl.)	**Cooking area** (Upper fl.)
Transforming Houses in two villages	85.7 (47.3%)	8.7 (4.8%)	13.2 (7.3%)	4.3 (2.4%)	12.7 (7%)
Houses in the buffer area	132.2 (46.9%)	172.5 (61.2%)	30.1 (10.7%)	5.5 (1.9%)	0 (0%)

Table 4.6.3 shows the areas of the major spaces in the *reproduction Thai house*. The central hall and the porch are the least changed compared with the central terrace and the verandah. It maintains the same proportion of an area as the archetype and the transforming house. The enclosed space is the most dramatically changed, starting the use of the space at the ground level. The bathroom at the upper level is common while the kitchen is relocated to the ground floor.

(a) (b)

Figure 4.6.5 Construction with concrete structures and brick walls at the ground level

(a) (b)

Figure 4.6.6 An air conditioning unit installed at outside wall of a reproduction Thai house

4.7 Conclusion

To measure the changes of the vernacular houses, the developments of the traditional houses to the transforming houses have been clarified in this chapter. The study shows that there are five major changes. The residents have typically developed their traditional house to a new form, which has unique features. The transforming houses are the combination of the old traditional building and modern constructions in accordance with the residents' lifestyle and domestic conditions.

The archetype is selected from one of the typical *vernacular Thai houses* with a popular image. It provides a typical knowledge for measuring the changes from tradition to contemporary. The settlement information clearly shows two types of the

beginnings of the samples: the relocated construction and the construction at original site. The *transforming Thai houses* are composed of both the traditional construction and the nontraditional construction. The proportion of merging these two constructions in the studied areas of the urban district village and the rural village is similar. It also shows some similarity of spatial arrangements in these houses. The *transforming Thai houses* in both two areas also can be divided into two types of construction. The first type is the houses that were transformed by extending the nontraditional part to join-up with the traditional structures. The second type is contemporary vernacular houses that were a newly-built house with the style of the *transforming Thai houses*. Although the house in second type in the studied areas was rarely found, this illustrates that the villagers prefer merging of the modernized and traditional forms.

The reproduction house is the vernacular house with modern facilities and popular image. Some of these houses have been used to claim the high status of the house owners. The shape, form, scale and space of the *reproduction Thai houses* have been significantly developed by the local traditional builders, and are very different from the *traditional Thai houses.* However, the houses are usually misinterpreted as *traditional Thai house*s.

The period of the modification and the extension in both the urban district and the rural villages related to the construction of roads. This study found that the roads, which have been constructed in the urban district villages before in the rural villages, have significantly influenced to the house modification with new materials. However, occurrences of the big fire in the rural villages caused some changes in house constructions before the beginning of the roads. The damaged houses had to be modified, extended, or reconstructed. The villagers chose to combine the remaining traditional structure with modernized form. From these factors, both actions (modification and extension) began in the rural villages earlier than in the urban district villages for decades because of the incidents of fire, especially in the 1930s. Although the actions of establishing contemporary vernacular houses in the urban district villages began later than in the rural villages, the numbers of these houses had strongly increased from the 1970s to the 1980s.

The process of change is usually composed of both modification and extension. The period of the major changes basically related to the period of these actions. In most samples, the transformation has occurred many times. The data,

which were mostly drawn from the residents, revealed the important events in the timeline and history of the villages. These events included construction of roads and walking bridges, disappearance of flood, and the damages of big fire. But the causes to change the houses, which were arrived from the interviews, were from shortage of land, an increasing of the family members, controls of hygiene, privacy and security, and changes of the residents' lifestyles.

The major changes are as follows: 1. changes of central terrace to hall and multi-step floors to a single floor level; 2. changes of an area underneath the house; 3. disappearance of a verandah and erection of a porch at the front of the house; 4. constructing bathroom at upper floor level; and 5. changes of kitchen unit to cooking space. However, the details of the materials used in each transformation will be discussed in Chapter 5.

The physical appearances of the vernacular houses have gradually changed from the *traditional Thai house* to the *transforming Thai house* over the last 50 year period. The roofs have been altered from the high-pitched roofs to the various-angle roofs. The small house units around the central terrace have been expanded to be bigger houses with a central hall. The multi-level floors between the main spaces have been adjusted to be flat floor level. Although these houses become a compact appearance within a smaller and narrower land, they contain a large space of interior.

The transforming houses have also been developed from the raised floor house to the house with more attached to the ground. At the front of the house, the porch is a replacement of the verandah which has been converted to be hall. The bathroom is always built from modern materials, which are contrast to the traditional materials at the upper floor level. The cooking space has been merged to the house, and could be noticed from its ventilation walls.

Although the transforming houses have become compact dwellings, they still maintain many features of the traditional house. The residents were confident to call their transforming houses as the archetype's name: *Reun Thai*. They believed that these transformations are the appropriate way to continue the use of their heritage. However, the artistic creativity and craftsmanship may be suspected to be in declining. Their changes and remaining will be studied in the next chapter.

In Chapter 5, the discussion about the transformation from this chapter will be continued and focused on the construction elements and materials. The key features will be defined and used for evaluating the changes in Chapter 6.

Chapter 5
Changes of Materials and Construction Elements

5.1 Introduction

In the previous chapter, this study clarified the causes and the process of changes in the physical appearance of the contemporary vernacular houses in the studied areas of the urban district village, the rural village and the motorway buffer area. This chapter aims to discuss further in the changes of materials and construction elements in these houses. The construction elements considered in this study include roof cladding and structure, columns, walls, beams, floors, and foundations. Changes of these elements are measured over a period from the 1800s to the 2000s. Quantitative data on the construction elements of the houses and the information from the interviews are used for supporting the discussion throughout this chapter.

The developments of 11 construction elements of the *transforming Thai houses* and the *reproduction Thai houses* are discussed in Sections 5.2 to 5.4 in order of their group of features: tradition, early industry (or intermediate) and contemporary. The data of physical appearances (shape, form, and size) are shown along with the information from the residents. The *transforming Thai house* and the *reproduction Thai house* are compared to evaluate the changes.

5.2 Development of construction elements

The discussion in this section is focused on the development of the construction elements. As discussed in Chapter 4, traditional elements have been gradually developed along with the transformations of the *traditional Thai houses*. The elements of the *reproduction Thai house*s have grown recently more from influences deriving from the modern housing market.

In order to obtain information during the survey period, construction elements in this study are categorized into eleven types (Figure 5.2.1): eight drawn from the *traditional Thai house* and three found both in the *transforming Thai house* or the *reproduction Thai house*.

To group these elements, the house can be conceived in three layers: the roof; the upper level, and the ground level (Figure 5.2.1). This division corresponds to the division used by local Thai builders who refer to them as Kreang-bon, Deau-lang, and Deau-bon respectively (Piromya 2000). The roof is comprised of cladding and structure. At the upper floor level, the construction elements are composed of columns, beams, walls, and floor cladding. At the ground level, the construction elements are columns and foundations (see the archetype of the *traditional Thai house* in Figure 4.4.2). Some elements are found only in the recent houses, either as a result of a transformation or a reproduction including beams, wall claddings, and floor claddings at the ground level.

The analysis of each element begins with a description of the archetype, drawn from previous studies. This is followed by comparisons of the findings from the house samples. The house samples are located in the urban district village, the rural village, and the motorway buffer area.

For the discussions about development, the house is divided into two parts: "traditional part" and "nontraditional part" (Figure 5.2.1). For the *transforming Thai house*, "traditional part" means the remaining part of the archetype and "nontraditional part" means to expanded or modified parts. For the *reproduction Thai house*, "traditional part" is newly construction, which has revived the appearance of the *traditional Thai house*, and "non-traditional part" is the newly constructed building, which is built in the contemporary type.

In Sections 5.3 and 5.4, various archetypes are selected from three historical groups: traditional, early industrial, and contemporary. These archetypes are drawn from the academic books which was recorded and accepted from Thai scholars. The features are classified by methods of construction (described in Section 2.4). Sources of three types of the archetypes are as follows:

1. Data on the traditional group are the house recorded by Jaijongrak (2000) in 1974 (described in Section 4.4 and see Figures 5.2.2 and 5.2.3). There are a few archetypes remaining in the urban district village with minor change of materials and construction elements.
2. Data on the early industrial group are the houses recorded by Soonthornsamai (1999) in 1973 (Figures 5.2.4 and 5.2.5). Additional data, which are provided by the Public Works Department of Thailand, present variety of construction elements in the 1960s. In the study area, private

houses, which are based on this archetype, were constructed in the intermediate period and are typically found in the surveyed areas.

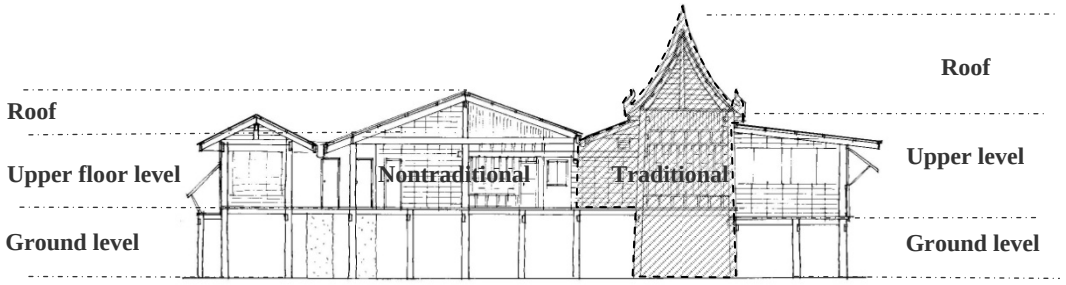
3. Data on contemporary group are recorded by Soonthornsamai (1999) in 1985 (Figures 5.2.6 and 5.2.7). Additional data, which are provided by the Public Works Department of Thailand, show variety of current construction elements. In the study area, private houses based on this archetype are usually constructed in the surveyed areas.

In those Sections 5.3 and 5.4, the discussions concentrate on shape, form, dimension, and categorization of each element in two groups: the *transforming Thai house*s in the urban district villages and the rural villages; and the *reproduction Thai houses* located in the motorway buffer areas. The uses of timber are discussed with vernacular name (Table 5.2.1). There are 71 examples (33 houses from the urban district villages and 38 houses from the rural villages) in the first group and 8 examples (from the motorway buffer area) in the second group.

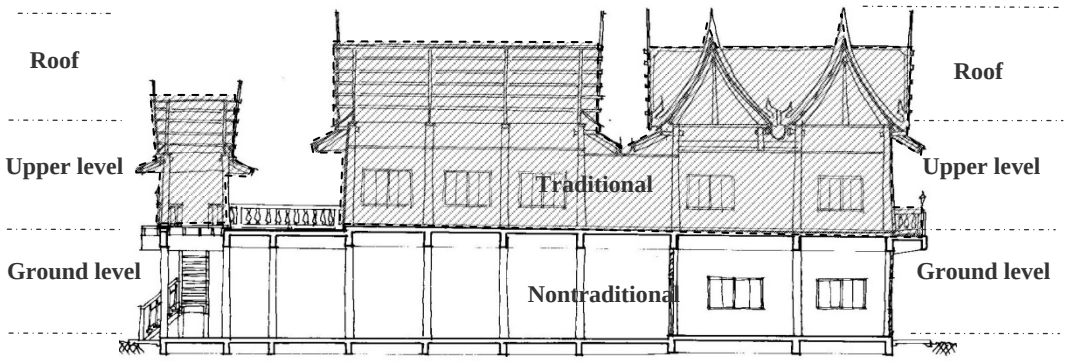
Table 5.2.1 Names and properties of timber used in the vernacular Thai houses

Vernacular Name	**Botanical Name**	**Bending Strength (Kg./m2)**	**Weight (Density) (Kg./m3)**
Teng	Shorea obtusa	1,732	964
Daeng	Xylia dolabriformis	1,447	890
Rung	Shorea siamensis	1,351	755
Teak	Tectona grandis	1,290	930
Makha	Afzelia xylocarpa	1,229	850
Tabaek	Lagerstroemia calyculata	1,219	680
Mahogany	Swietenia macrophylla	1,210	530
Takean thong	Hopea odorata	1,172	649
Pine	Casuarina junghuhniana	1,040	420
Rubber wood	Hevea brasiliensis	888	470

Sources: Developed from *The encyclopedia of wood* (Davidson and Freas 1989)



Transforming Thai house

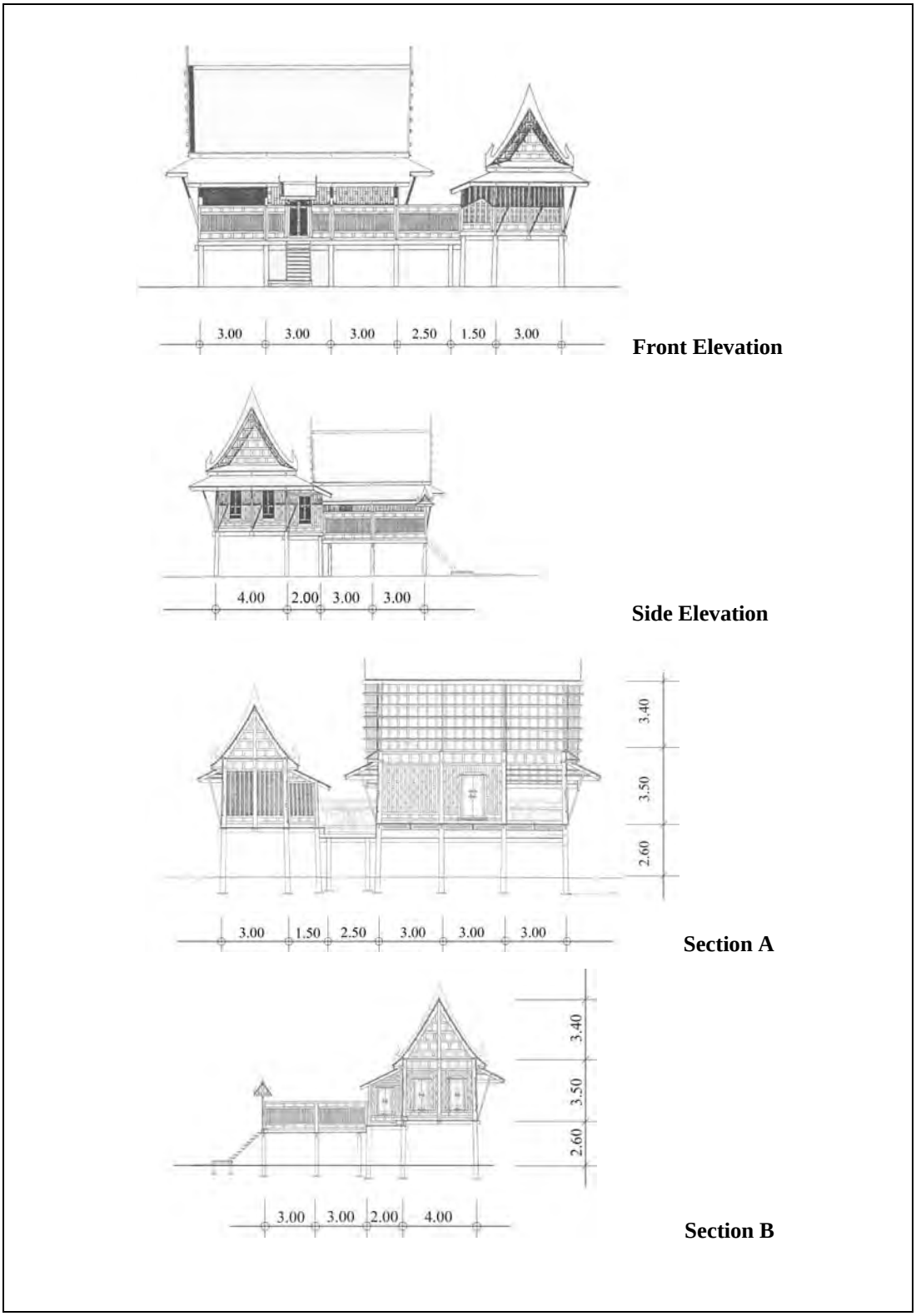


Reproduction Thai house

Construction Elements (Found at the archetypes)
Roof: 1. Cladding and 2. Structure
Upper level: 3. Column, 4. Wall, 5. Beam and 6. Floor
Ground level: 7. Foundation and 8. Column
Construction Elements (Found at the recent constructions)
Ground level: 9. Wall, 10. Beam and 11. Floor
Key of shading: = Traditional part = Nontraditional part

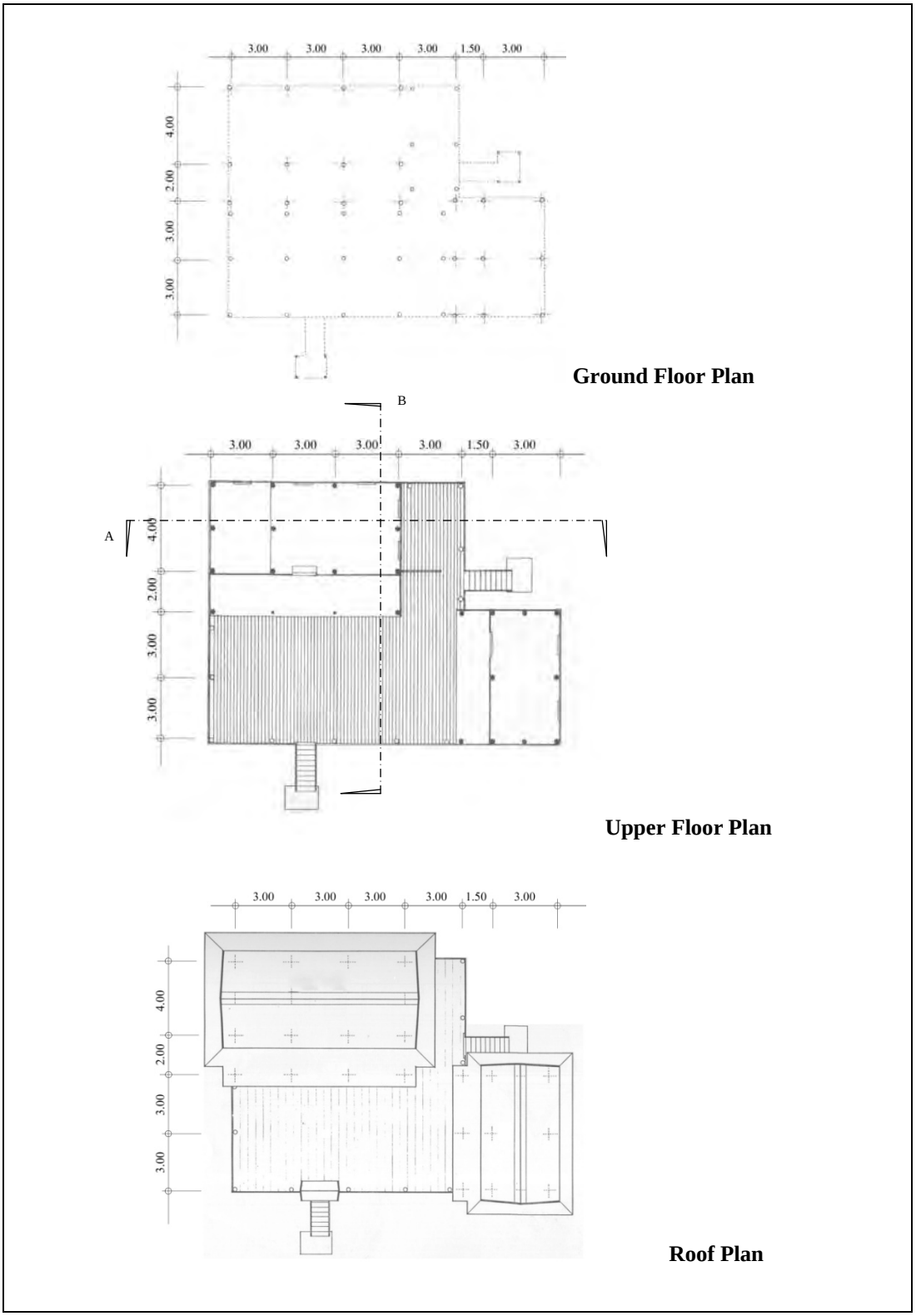
Source: Transforming Thai house: House no. E-LD-10 and Reproduction Thai house: House no. CH-BH-12

Figure 5.2.1 Section of the *transforming Thai house* and the *reproduction Thai house* presenting 8 traditional construction elements and 3 recent construction elements



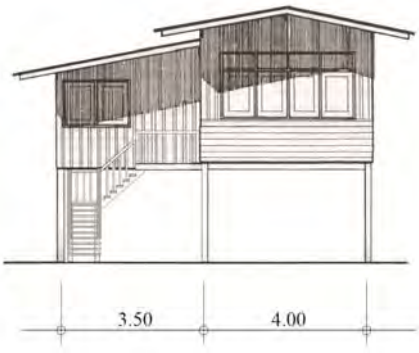
Source: Adjusted from Jaijongrak, 2000

Figure 5.2.2 Elevations and sections of the archetype of the traditional Thai house in Central Thailand

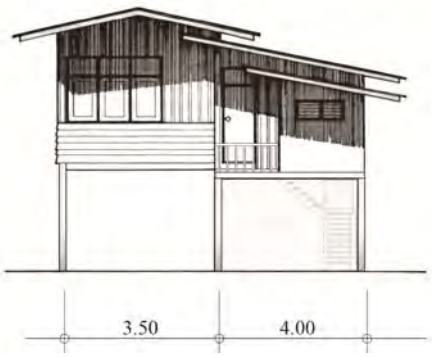


Source: Adjusted from Jaijongrak, 2000

Figure 5.2.3 Plans of the archetype of the traditional Thai house in Central Thailand

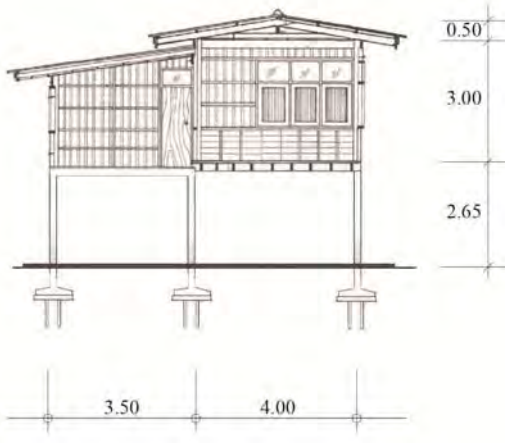


Front Elevation



Back Elevation

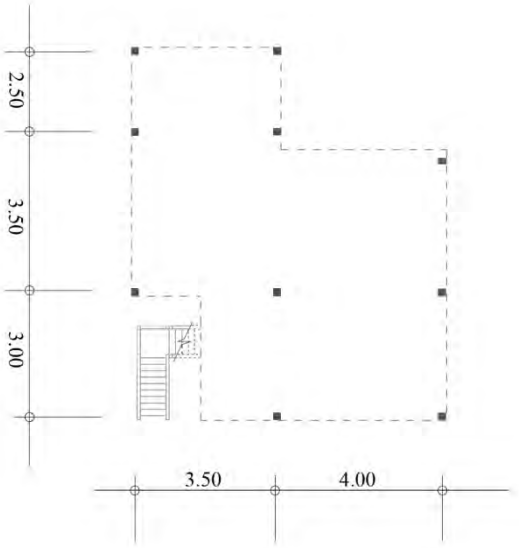
Side Elevation



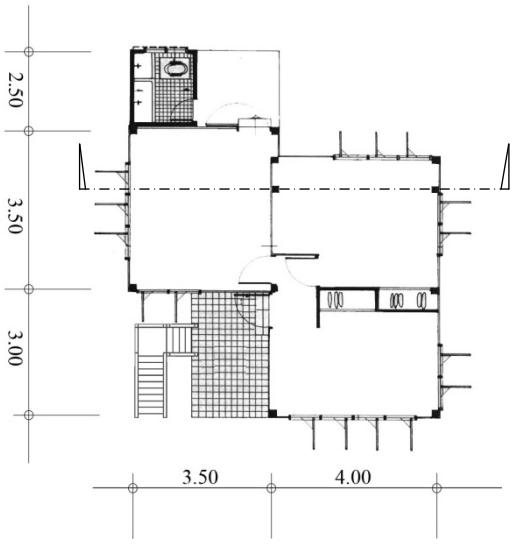
Section

Source: Adjusted from Soonthornsamai (1999)

Figure 5.2.4 Elevations and section of the archetype of the early industrial (or intermediate) period house in Central Thailand



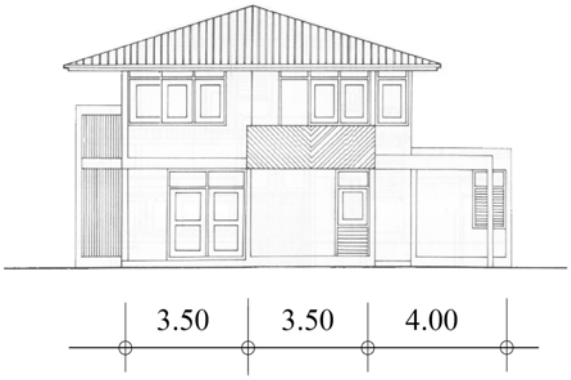
Ground Floor Plan



Upper Floor Plan

Source: Adjusted from Soonthornsamai (1999)

Figure 5.2.5 Plans of the archetype of the early industrial (or intermediate) period house in Central Thailand



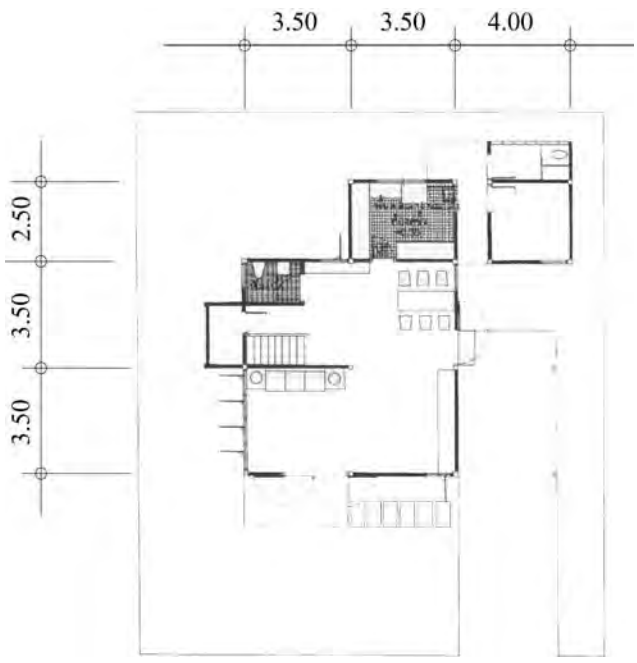
Front Elevation

Section A

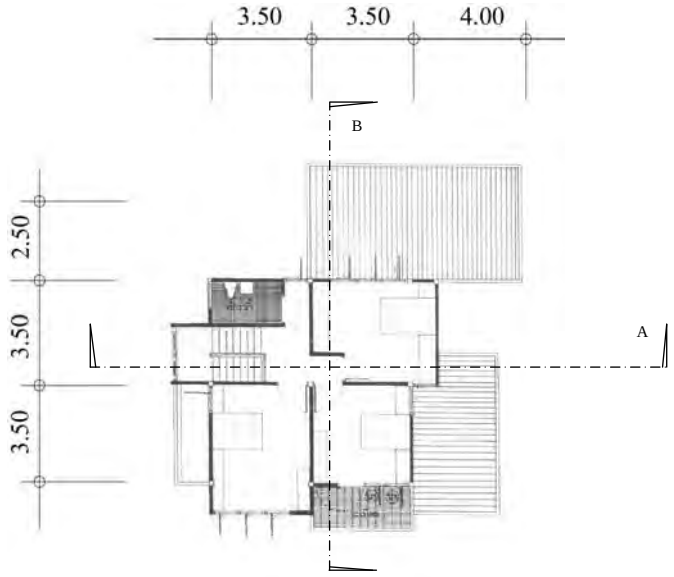
Section B

Source: Adjusted from Soonthornsamai (1999)

Figure 5.2.6 Elevations and sections of the archetype of the contemporary house in Central Thailand



Ground Floor Plan



Upper Floor Plan

Source: Adjusted from Soonthornsamai (1999)

Figure 5.2.7 Plans of the archetype of the contemporary house in Central Thailand

5.3 Elements of roof construction

Roofs of Thai houses share the primary form, the gable roof, of dwellings found throughout Southeast Asia and some parts of East Asia (Sthapitanonda 2006). The roofs of the *traditional Thai house* developed from early traditional houses, constructed with thatched roofs and bamboo structures. Some studies (Tamiyabandha 1995, Piromya 1995) claimed that roofs are the most dominant of form in Thai traditional architecture.

In Figure 5.3.1 (A), a traditional gable roof, built with steep pitch (55-60 degrees) and concave shape is shown. Slightly curved lines form the ridge, rafters and bargeboards. Additional eaves on four sides provide protection from intense sunlight and monsoonal rain. On the side overlooking the central terrace, the eave is cantilevered and supported by brackets to create a shady area. The main decorative feature is the bargeboard, which covers the edge of the roof at the gable ends. It also has the important function of preventing wind from displacing the thatch or the roof tiles.

Figure 5.3.1 (B) shows the gable roof of bungalow style. This is an undecorated gable roof with very low slope (15-20 degrees). There is no additional eave, found in a traditional gable roof. The bungalow roof began to be used in the modernized period and was developed along with the introduction of many industrial materials (Puwanan 2004).

Figure 5.3.1 (C) shows the roof of a contemporary house. It is a hipped-gable roof, sloping on all four sides. The hipped-gable roof combines the hipped form with gables at the pitch on both sides. The hipped-gable roof began to be used in Thailand during the colonial period (1800s-1900s) and was common as well in neighboring countries (Sthapitanonda 2006). At present, both hipped and hipped-gable (or half-hipped) roofs are commonly used in most of the houses built recently in Thailand (Puwanun 2004). The roof cladding most commonly found in the surveyed areas is cement tiles.

5.3.1 Roof Cladding

Roof cladding is directly exposed to the effects of heavy rain, intense sun and high humidity. The roof traditionally covers all house components, apart from the

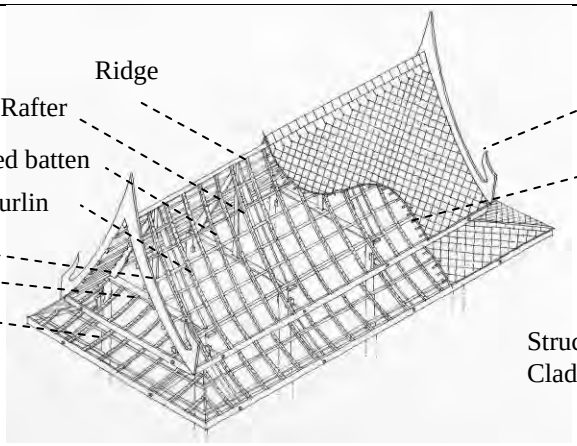
terrace. Hence, roof cladding is repaired or replaced more frequently than other elements.

Figure 5.3.1 (A) shows three traditional types of roofing, including thatching, clay tiles, and ceramic tiles. Thatch used to be main roofing material for the *traditional Thai houses* (Figure 5.3.3), but was later replaced by clay tiles. From the interviews, it is apparent that thatched roofing has not been used with the houses in the surveyed locations since the early 20th century. However, thatched materials may still be used for roofing in many small or temporary buildings (e.g. field shelters, roadside sheds, stalls and rice barns). According to Jaijongrak (2000), the examples of thatched materials used in the traditional house were grass: faek (Vetiveria zizanioides and nemoralis) and ya kha (Imperata aundinacea); and palm leaf: Nypa (Nypoideae) (Figure 5.3.4).

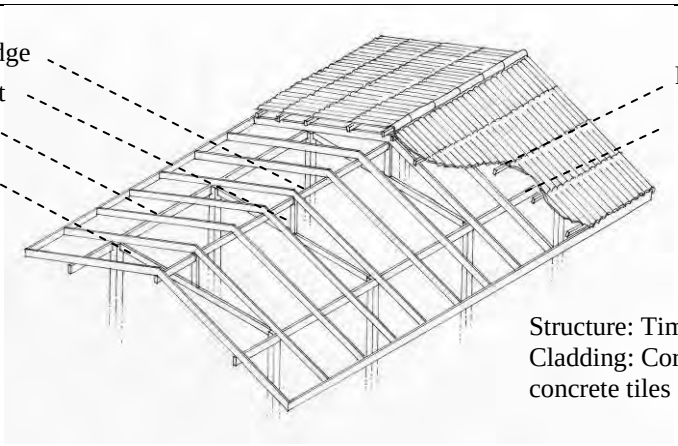
Clay tiles paralleled the development as bricks and were typically fired within the same kiln. A few uses of the clay tiles are found in the *transforming Thai houses* in the villages. The tiles are more durable than thatched materials but need to be partially replaced every few years as they get damaged or lost in strong winds. Local builders in the buffer area explained that the damage occurs because of the inconsistent shape of tiles from the local factory.

Ceramic tiles are similar to the local clay tiles but are more recently produced in the modern factories and have more durability and a greater range of colors. The styles often imitate the clay tiles. They have been produced for Thai temples since the fourteenth century and for Thai-style public buildings more recently. In Thailand, people in the past did not like to build their houses with the same materials as temples or palaces because of their cultural beliefs (Piromya 1995). Respect for hierarchy is a very important value for Thai people. There are a number of Thai customs relating to the special status of monks and royal family in Thai society. The residents stated that this belief has been retained in their villages for many centuries, but has decreased recently. The ceramic tiles are the only traditional materials used in the *reproduction Thai houses* in the buffer area with high proportion.

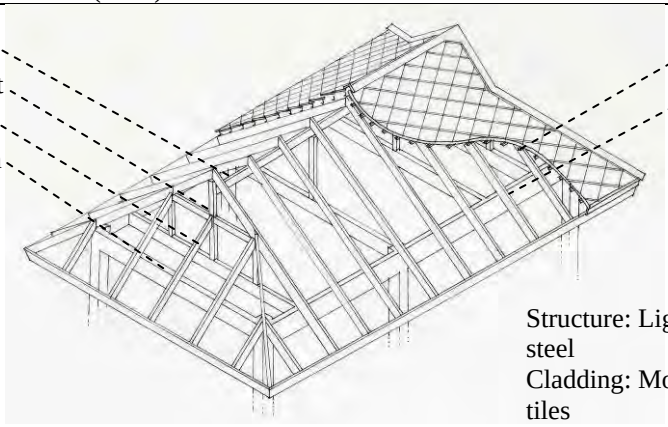
In the traditional part of the *transforming Thai houses*, a few of the roof cladding are still clay tiles. The residents said that clay tiles have usually been damaged and need to be replaced. Most owners replaced or wish to replace clay tiles with other modern materials, such as corrugated cement tiles if they have the



A) Traditional
Source: Traditional Thai house (Jaijongrak 2000)



B) Early Industrial
Source: Standard house in Central Thailand in the 1960s, provided by the *Public Works Department* of *Thailand* (2009)



C) Contemporary
Source: Standard house in Central Thailand in the present, provided by the Public Works Department of Thailand (2009)

Note: The illustrations show the roof covering and structure.

Figure 5.3.1 Archetypes of the roof in traditional, early industrial and contemporary groups

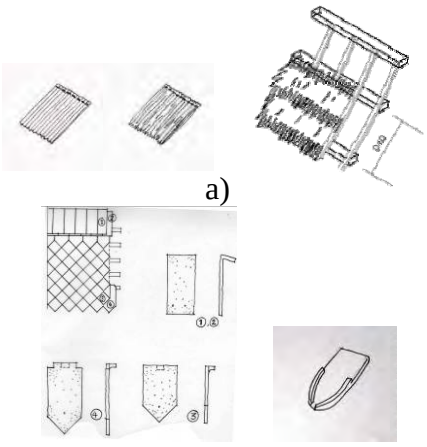
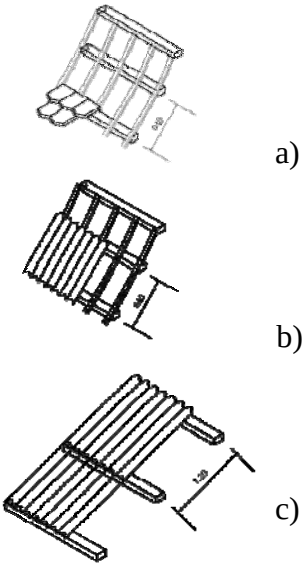
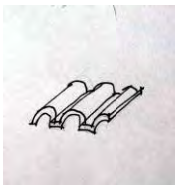
	Drawing	Description/Size
A) Traditional	 a) b) c)	a) Palm leaf or grass thatch / Size of bamboo batten grid: 35x100 cm b) Clay tiles / Thickness: 0.5-0.8 cm, long: 10-20 cm. c) Ceramic tiles / Thickness: 1.0-1.2 cm, long: 12-15 cm.
B) Early Industrial	 a) b) c)	a) Local cement tiles / Thickness: 0.5-0.8, long: 10-20 cm b) Corrugated cement tiles / Sawn to fit with traditional purlins / Thickness: 1.0-1.2 cm, long: 60-120 cm. c) Corrugated metal sheets / Long: 100-120 cm.
C) Contemporary		Modern concrete tiles / Thickness: about 2 cm, long: about 33-35 cm

Figure 5.3.2 Drawings of the roof claddings in traditional, early industrial and contemporary groups

resources. The traditional or historic appearing portion of *reproduction Thai houses* is mostly covered with ceramic tiles. Only one house was covered with corrugated concrete tiles. These ceramic tiles are more durable than traditional clay tiles and can be attached firmly to the battens using wires.

Figure 5.3.3 Thatch roofs of a floating house in Bangkok during the 19th century (Source: The Siam Photo Studio)

(a) (b)

Figure 5.3.4 Thatched grass found in a shelter or a house in the ethnic group village in Central Thailand

Figure 5.3.2 (B) shows three early industrial types of roofing with examples of local cement tiles, corrugated metal sheets, and corrugated cement tiles (Figure 5.3.5). Local cement tiles were produced with the same shape and size of clay tiles. Similar to clay tiles, these tiles can be easily damaged from strong wind. They have to be installed on traditional structures using battens. The uses of these tiles were rarely found with the *transforming Thai houses* in the villages.

Both corrugated materials are durable, easy to handle and can be fixed to the roof frame structures with nails or screws. Compared to clay tiles, they are less prone to leaks and more resistant to damage from fire and dampness. Corrugated metal sheet rusts when its coating wears off and hence requires regular maintenance. Many uses of these materials are found in the *transforming Thai houses* in the villages. The corrugated metal sheets are used less than the corrugated cement tiles.

In the traditional or historic parts of the *transforming Thai houses*, builders slightly modify the traditional structure when covering with corrugated materials by taking the tile battens out. Local builders in both villages commented that corrugated materials are suitable for the traditional structure because of their light weight (13-15 kilograms per square-metre). In addition, these materials can be easily cut to size, making them appropriate for concave rafters and purlin interval (50-60 centimetres). Most of the traditional roofs in the *transforming Thai houses* were changed to be the corrugated materials.

The nontraditional parts of the *transforming Thai houses* are mostly covered with corrugated materials. The corrugated cement tiles are the most common type used. These tiles have been produced for a long period and originally contained asbestos (Taptagaporn and Siriruttanapruk 2002). The Hazardous Substance Committee (Department of Industrial Works of Thailand 2004) has placed asbestos under review with plans to ban asbestos in the near future.

Although the corrugated pattern of cement tiles is normally larger than a pattern of metal sheets, these two roofing materials have a similar size and require a similar supporting structure. They can be used as replacements for each other, but most corrugated metal sheets have been replaced by corrugated cement tiles more recently. Many residents in both villages agreed that houses covered with corrugated cement tiles keep their house at a lower temperature during the day. They also explained that rain water, collected from the roof made of corrugated cement tiles, can be used for drinking and cooking as it has less pigment than corroded corrugated metal sheets.

From the residents' point of view, the corrugated cement tiles are the most appropriate materials for house roofing. These materials are still produced and come from modern factories. Only a few residents are aware of the danger of asbestos.

(a) (b)

Figure 5.3.5 Roof cladding in the intermediate group:
(a) Corrugated metal sheets and (b) Corrugated cement tiles

Figure 5.3.2 (C) shows one of the most common contemporary roofing materials, modern concrete tiles (see Figure 5.3.4). These tiles are very popular for contemporary houses. However, there are only a few instances of use of these kinds of tiles in the *transforming Thai houses* in the villages and no instances of use in the buffer zone. Modern concrete tiles are very durable and heavy (40-41 kilograms per square-metre) compared to the corrugated materials (13-15 kilograms per square-metre). Flat slab concrete roofs are discussed in the nest sub-section. Local builders explained that these tiles are too heavy for the typical roof structures in the villages, leading to their relative lack of popularity.

The nontraditional part of the *reproduction Thai house* is the construction without pitch roof covering roof at the ground level. The roof of this construction is a flat slab concrete and commonly used as a terrace (Figure 5.2.1). It is made of reinforced concrete and covered with ceramic floor tiles.

In conclusion, it is found that roofing from the intermediate group continues to be in use. The old and damaged corrugated materials are typically still replaced by similar corrugated materials. In contrast, more modern types of concrete tiles have not been used in the surveyed houses.

5.3.2 Roof Structure

The roof structure of the *traditional Thai house* is the most complex element, especially when compared to the other features of the house type. It consumes more time to build and requires highly skilled labor. The roof structure functions not only

as protection of the house but as an ornamental element as well. It is typically constructed without a ceiling. Damage to the roof structure is usually caused by a lack of maintenance of the roof cladding. Modification, relocation, or reassembly of some houses may affect the roof shape and can lead to damage. The roof structure is normally well protected from the environment. However, the purlins and the ridge at the gable rims are exposed to the environment and typically decay due to dampness from rain.

From the traditional group in Figure 5.3.5 (A), the main components of the traditional roof are composed of the rafters, the tie beams, the king posts, and the ridge. The roof structure is made of two hardwoods: teak (Tectona grandis) and teng (Shorea obtusa). Teak is mostly used in both the *reproduction Thai houses* in the buffer area and in the *transforming Thai houses* in both villages. Teak is typically found in the traditional part of the surveyed houses.

According to Piromya (1995), tie beams, battens and gable-rim bargeboards are unique to central Thai houses, especially when compared to the gable-roof approximately 5 x 20-25 centimetres) are set horizontally and tied between rafters.structures in other regions of Thailand. The cross-roof beams (measuring Battens are separated into 2 types: Klorn and Ranang. Klorn is an inclined batten made of flat timber (approximately 2.0 x 7.5 centimetres) and placed on top of the purlins. This batten is used for thatched materials. Ranang is a horizontal batten (approximately 3.5 x 3.5 centimetres) and placed on top of the Klorn in order to support clay tiles. Bargeboards at the gable rims are placed to protect thatch or tiles from the wind. Jaijongrak (2000) has stated that these bargeboards emphasize the curve of the steep roof and are carved in a horn-like shape at the lower ends (Figure 5.3.7).

The core sections of the *transforming Thai house* show the continued use of the traditional structure. Owner have taken the battens *(*Klorn and Ranang) out in most cases and covered them with corrugated roofing. Corrugated roofing can be nailed or screwed to the purlins without major roof modifications. There are three houses in the urban district village with distorted traditional structures. These structures are now supported by timber props, which were used as cross members. Most of the traditional structures were found in good condition although there is leaking of the roof cladding in some houses.

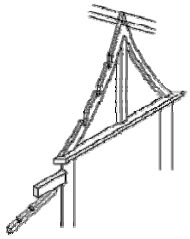
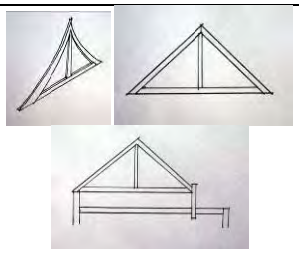
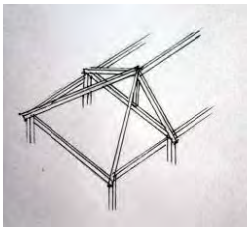
	Drawing	Description/size
A) Traditional		Timber structure, steep slope roof with curvy rafter and flat cross-roof beam / Size of section: flat tie beam about 5x20 cm., rafter about 5x25 cm. and king post about 5x20 cm.
B) Early Industrial	 a)  b)  c)	a) Timber structure, modification of traditional gable form, Medium slope roof with straight rafter / Size: the same as the traditional structure b) Timber structure, gable or hip form, Low slope roof / Size of section of tie beams, roof beams, and rafters: about 5x15 to 5x20 cm. c) Timber structure, hip form, Medium slope roof / Size of section of tie beams, roof beams, and rafters: about 5x15 to 5x20 cm.
C) Contemporary	 a)  b)	a) Light-gauge steel, Truss frame, low angle roof slope/ gable or hip form / Size of section: roof frames 5x10 to 5x15 cm. b) Flat roof, Slab-on-beam concrete, Thickness: 10-12.5 cm.

Figure 5.3.6 Drawings of the roof structure in traditional, early industrial, and contemporary groups

Figure 5.3.7 Bargeboards of the traditional roof structure

The traditional aspect of the *reproduction Thai houses* follows the precedent of the archetype except for the use of nails in unseen components such as battens. The difference of these structures from truly traditional building is the layout of multi-roofs which are connected to each other without the gap of the central terrace (Section 4.6). These roof structures are normally intended to be seen from the inside, but in some examples the undersides are wholly or partially hidden by ceilings. This often occurs due to the use of air-conditioning at the upper level. From interviews with local builders, there is one house in the buffer area that uses structural steel for the part of structure. This house was inaccessible and is not included in the sample.

An overview of the intermediate group in Figure 5.3.5 (B) shows that all of the roof structures have timber frames. Most of the timbers are domestic hardwood but imported timbers are also used. A large number of uses of Teng (Shorea obtuse) are found in the *transforming Thai houses* in the villages. The other timbers such as Daeng (Myrtaecae) are used to a lesser extent. The drawings in this group show three types of roof structure: modified traditional; gable with low pitch; and hipped with medium pitch. The imported timbers are softwood species, such as pine (Casuarina junghuhniana), and hardwood species, such as Mahogany (Swietenia macrophylla) and Eucalyptus (Camaldulensis eucalyptus). Mahogany is the most commonly used imported timber in the villages. The modified traditional structures appear to have some components that differ from the archetype. These roof structures were built with ordinary tie beams or straight rafters. Some structures were built with double tie beams to increasing the roof span.

Gable structures of low pitch were typical of bungalow-style houses. Compared to the traditional roof structure, the angle of this roof considerably is reduced from 55-60 degrees to 10-20 degrees as a result of the corrugated roofing. Corrugated metal can drain rainwater better and is more durable and, therefore, does not require such a steep pitch. This roof is simple and quicker to build compared to the traditional roof.

The hipped structure was used in houses influenced by late colonial or contemporary styles (Figure 5.3.7). The roof angle is typically 30-45 degrees. The roof structure is more complicated than that of older roofs with valley rafters, hip rafters and jack rafters.

The most nontraditional aspect of some *transforming Thai houses* is the presence of a gable structure with low pitch, similar to the bungalow style roof. The hipped roof is found in few cases and always mixed with the bungalow style roof. The materials are the same hardwoods as used in the *traditional Thai house* structure. However, the section of timber is smaller because of the lighter weight of the corrugated roofing materials.

Figure 5.3.8 Hipped roof of a vernacular house in the urban district village

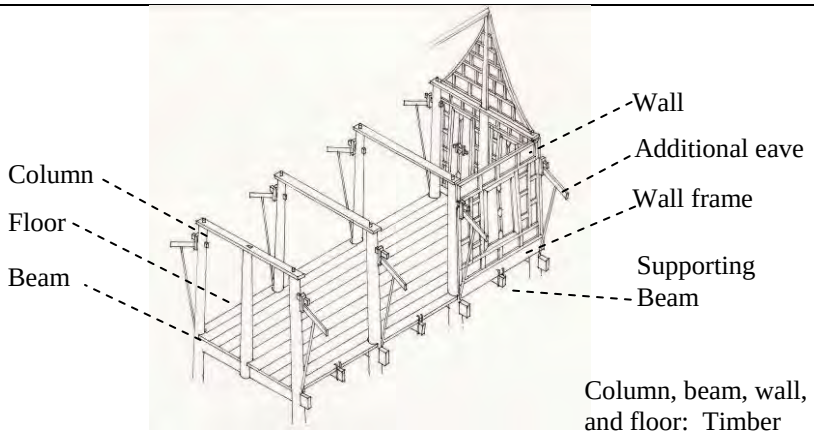
Figure 5.3.5 (C) shows the contemporary roof of the houses recently constructed in the surveyed areas. The hipped or hipped-gable roof is a popular style at present. It is usually built with square shape light-gauge steel (50x25x1.6-2.3, 100x50x2.3-3.2, and 125x50x2.3-3.2 mm.) and lip channel light-gauge steel (100x50x20x2.3-3.2, 125x50x20x2.3-3.2, and 150x50x20x2.3-3.2 mm.).

Some houses, which are not in the samples, were built with timber. The light-gauge steel members are welded on-site to form roof trusses. These roof structures are strong enough to carry the weight of the concrete tiles, which are the most popular cladding materials. Similar to the hipped roofs in the intermediate group, the roof angle in the contemporary group is 30-45 degrees. However, the contemporary roofs are hardly found in the *transforming Thai houses* in both villages and no use in the buffer area.

A flat roof is not popular to cover a whole roof but is usually built in just some parts of a roof, which function as a terrace at the upper level. Flat roofs are always found with the contemporary houses in every surveyed location and built in-situ with concrete. The uses of flat concrete roofs are frequently found in the *reproduction Thai houses* in the buffer area.

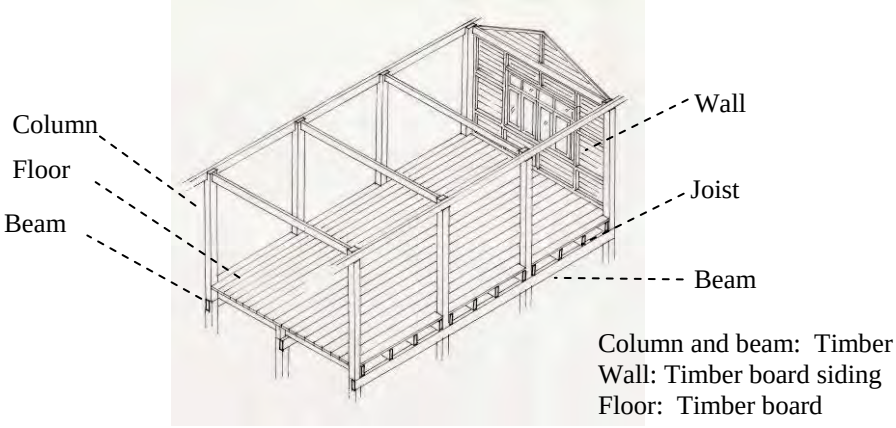
The most "untraditional" part of the *reproduction Thai house* is the flat-roofed structure. In-situ concrete is used for the roof which also functions as a terrace. This structure is built without a waterproof membrane or thermal insulation but is typically covered with ceramic floor tiles. This roof is found in every surveyed house in the buffer area.

From purposes of discussion, the traditional roof structures for traditional houses have mostly remained unchanged, although battens have been removed when corrugated materials have come into use. There is no reproduction of traditional roof structures in the samples of the *transforming Thai houses*. All extensions for this type of building are built with bungalow or hipped style roofs. The traditional roof structures are reproduced only in the buffer area. Most of them are built by professional builders and present a high level of craftsmanship.



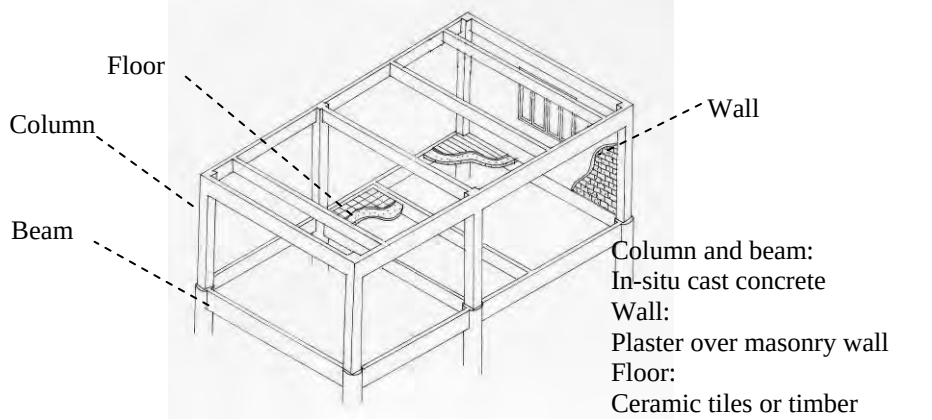
A) Traditional

Source: Traditional Thai house (Jaijongrak 2000)



B) Early Industrial

Source: Standard house in Central Thailand in the 1960s, provided by the Public Works Department of Thailand (2009)



C) Contemporary

Source: Standard house in Central Thailand in the present, provided by the Public Works Department of Thailand (2009)

Note: The illustrations show columns, beams, walls and floors at the upper level.

Figure 5.4.1 Archetypes of the upper level construction in traditional, early industrial, and contemporary groups

5.4 Elements beneath roof constructions

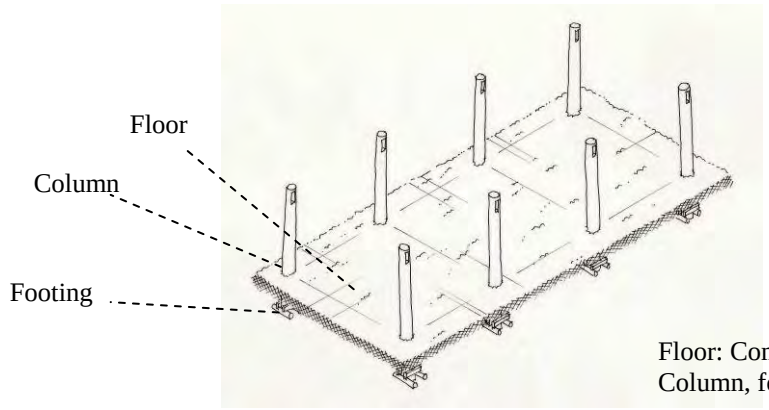
Beneath roof constructions, the main construction elements for all vernacular Thai houses are columns, walls, beams, and floors. They are categorized at two levels: the upper level and the ground level. The living spaces and all enclosed areas of the *traditional Thai house* were located at the upper level. A raised house on high columns is one of the primary images of the *traditional Thai house* (Jaijongrak 2000). The houses were constructed as raised dwellings especially in flooded locations (Sections 4.3 and 4.4). At present, the absence or decline in the number of floods has increased the opportunity for resident to live permanently at the ground level.

In the *traditional Thai house*, space under a raised house had multiple functions. However, these activities were normally limited to the daytime because there is no enclosed space. At the ground level, there were traditionally only two construction elements: the foundation and the column. The other construction elements: walls, beams, and floors were added or newly constructed to provide an enclosed space in the *transforming Thai house* and the r*eproduction Thai house.*

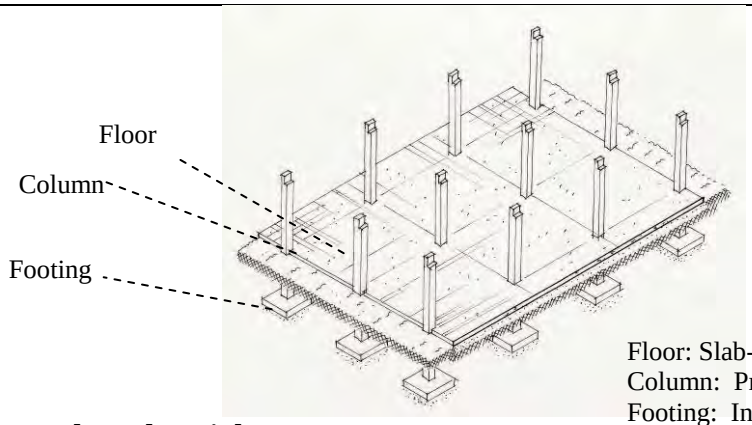
At the upper level, the construction elements are composed of columns, walls, beams, and floors. Figure 5.4.1 illustrates the upper level archetypes in three historical groups: the traditional, the early industrial, and the contemporary.

Figure 5.4.1 (A) shows the columns and walls of the *traditional Thai house*. Significantly, all of these incline inwards. As a result of this, the floor area is slightly larger than that near the roof. According to interviews with professional builders in the buffer area, the leaning walls and columns provided for greater stability of timber houses during flooding or rainstorms. Piromya (1995) explained that the leaning construction adds to the strength of prefabricated connections. Jaijongrak (2000) mentioned that the degree of incline is about 1.5 degrees from perpendicular. However, the degree of incline is slightly different and depends on various builders' own rules.

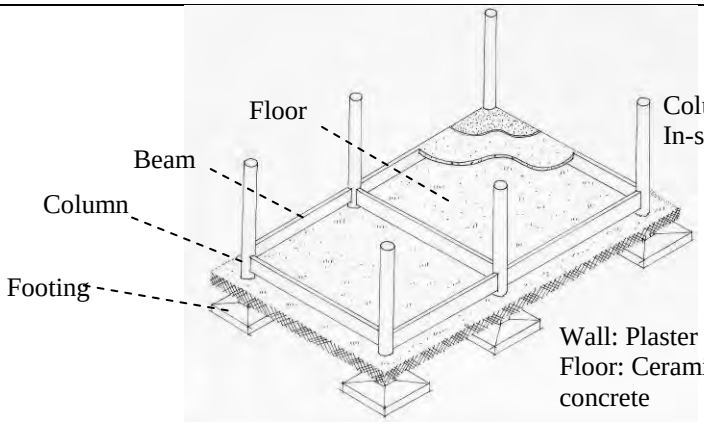
Figure 5.4.1 (B) shows the upper level of a bungalow-shaped construction in the *transforming Thai house*. Its structure was built with timber beams and columns, enclosed with weatherboards. The layout, plan, form, and dimension depended on function, land shape, budget and modern materials. The construction methods such as nuts and bolts system from the intermediate period began to be used with this type of dwelling. The residents in the surveyed areas stated that their house is affordable



A) Traditional
Source: Traditional Thai house (Jaijongrak 2000)



B) Early Industrial
Source: Standard house in Central Thailand in the 1960s, provided by the Public Works Department of Thailand (2009)



C) Contemporary
Source: Standard house in Central Thailand in the present, provided by the Public Works Department of Thailand (2009)

Note: The illustrations show ground level columns and foundations. They also show some recent construction elements (beams, walls and floors at the ground level).

Figure 5.4.2 Archetypes of the ground level construction in traditional, early industrial, and contemporary groups

used for the bedroom and lavatory area. Contemporary houses in the surveyed locations often have small terraces made of concrete next to bedrooms.

At the ground level, the construction elements are composed of columns, walls, beams, floors, and foundations. However, only columns and foundations are found in the traditional archetype. Figure 5.4.2 illustrates the archetypes at the ground level of the three historical groups.

Figure 5.4.2 (A) shows two construction elements: columns, and foundations. Compared to the elements at the upper level, these are simple and consist of only a small number of elements at the ground level. Columns incline inwards at the same angle as the upper level columns. Floors consist of compacted soil and there are no walls or beams at this level. Footings are composed of logs and beams without piles.

Figure 5.4.2 (B) shows the ground level of bungalow-type construction. Columns are built with timber or precast concrete members and footings are built with in-situ cast concrete. Following the example to traditional houses, there is commonly no ground level beams or walls. The floors consist of compacted soil or concrete. However, an enclosed space is found in some cases. This is built with corrugated materials wall and usually has concrete floor. The layout and plan of this construction commonly follows that of the upper level. There are some houses where the ground level layout is larger than that of the upper level.

Figure 5.4.2 (C) shows a reinforced concrete structure built using an in-situ cast concrete. In the contemporary house, the spaces at ground level are usually used as living rooms, dining rooms, kitchens and toilets. Footings with concrete piles are typical. The precast concrete floor is alternatively employed to reduce the time needed for construction. Concrete is extensively used for columns, beams, floors, and footings. The construction at the ground level is sometimes covered by either a pitched or a flat roof.

5.4.1 Columns

In Figure 5.4.3 (A), the traditional column had a round (circular) section. This was typically one solid piece of timber running from the ground to the top without any joints. The column was inclined inwards, as mentioned previously. With the scarcity of timber, a single long log for the column became too expensive. Thus, the use of two columns, connected at the upper floor level, became more practical and is sometimes used in more recent constructions.

Timbers used for the traditional columns at the upper level and the ground level are generally similar. The upper level columns are mostly made of Teak (Tectona grandis) and Teng (Shorea obtuse). Most of the ground level columns are also made of the same woods: Teak and Teng. The rest are Rung (Shorea siamensis), makha (Afzelia xylocarpa), or Dang (Myrtaecae).

Figure 5.4.3 (A1) shows a traditional column at the upper level. This is attached to a roof tie beam at the top. Typically, the top end of column is shaped as a round-shaped tenon to connect with a tie beam (Figure 5.4.4). The column is also mortised to receive the structural frame of an additional eave (see Figure 5.4.1 a). The diameter of the upper level column is about 22-23 centimetres at the base and about 20 centimetres at the top.

Figure 5.4.3 (A2) shows a traditional column at the ground level. This is frequently damaged by seasonal floods and termites. It therefore needs repairs or replacement on a regular basis. The column is mortised to receive the floor beam. Its diameter is approximately 25 centimetres at the base and approximately 23 centimetres at the top. The column is placed on a timber footing at 0.80-1.00 metres below ground level.

Most columns at the ground level have been replaced in recent years by precast concrete columns. This has taken most recently in the urban district village. In contrast, the timber columns have been often used for replacement or repair in the rural village. Some timber columns with mortise-and-tenon connections are still used for replacements. However, most of the new columns, either precast concrete or timber, are connected to the old columns with bolts or nails (Figure 5.4.5).

Figure 5.4.3 (B) shows a precast concrete column, a timber column, and a steel column. The section of square concrete and timber column measures around 20 x 20 centimetres. These columns do not lean inwards and are not tapered at the top. They are made by the same type of hardwood as traditional columns. In these examples, the columns are connected to the ground level columns, which are made of timber or precast concrete. Between the columns, the timber stud (2.5x7.5 centimetres in section) is used to fix weatherboard walls using nails.

Steel columns are used in some areas of the house to support the roof structures of modified or new sections. The diameter of a round steel column is approximately 7.5 centimetres. This steel column is light and can be placed on a timber board or concrete floor.

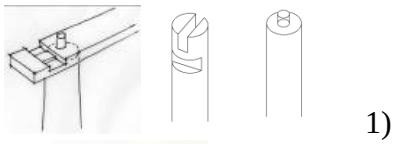
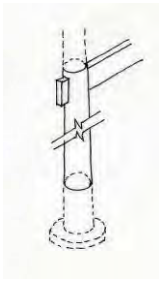
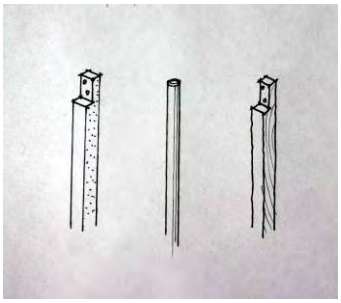
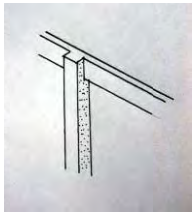
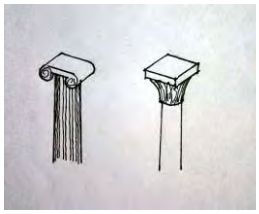
	Drawing	Description/size
A) Traditional	 1)  2)	Columns made of timber / round-shape / Mortise-and-tenon joint / Tapering at the top 1) Upper floor level column: 20-23 cm in diameter 2) Ground level column: 23-25 cm in diameter
B) Early Industrial	 1) 2) 3)	1) Reinforced concrete column / rectangular shape / Cross section: about 20x20 cm 2) Steel column / round-shape / Diameter: 7.5-10 cm 3) Timber column / square-shape / Cross section: about 20x20 cm
C) Contemporary	 1)  2)	1) In-situ cast concrete column / rectangular shape / Cross section: about 20 x 20 cm 2) In-situ cast concrete column / rectangular or round shape with plaster ornament / Cross section: 20-25 x 20-25 cm

Figure 5.4.3 Drawings of the column in traditional, early industrial and contemporary groups

(a) (b)

Figure 5.4.4 Upper level columns: (a) Mortised traditional columns; and (b) Tie beams between columns

(a) (b)

Figure 5.4.5 Ground level columns: (a) Precast concrete columns in the urban district village and (b) Timber columns in the rural village

In the new parts of the *transforming Thai house*, the support is mainly square timber columns at the upper level and precast concrete columns at the ground level. The in-situ cast concrete columns are found in bathroom constructions at both the upper and ground levels. The residents stated that they prefer to use timber columns at the upper level. However, they accept the use of in-situ cast concrete columns in the bathroom at the upper level to prevent damage from moisture. For the same reason, precast concrete columns often replace decayed wood columns at the ground level. The bathroom is commonly built only at the upper level. There are only a few houses in the rural village in which the bathroom is built at the upper level with timber.

The concrete and timber columns measure about 20 x 20 centimetres in section and 3 metres in length. The upper level column is cast in place, allowing for a

firm connection to the ground level columns by bolts (see Figure 5.4.3 b). The column is also interlocked with the upper level floor beam.

At the ground level, timber and concrete columns are used in combination in most of the house samples. Some houses are built with only concrete columns; and a few houses are built with only timber columns. There are examples of steel columns as well. In these cases, only a few steel columns (one or two columns) are used in each house.

Figure 5.4.3 (C) shows two types of column used in contemporary buildings: an in-situ cast concrete column, and an in-situ cast concrete column with a plaster decoration. The size of a square or round column is approximately 25 x 25 centimetres but is sometimes larger when plaster decoration or moldings are applied. The actual columns are normally placed on the footing using concrete piles. In the 1990s, there was a widespread use of classical styles (Greek or Roman styles), which employed many classic style elements for decoration both inside and outside the building (Horayangkura 2000). This style was applied and developed on both public buildings and houses. In the surveyed location, some columns in the contemporary house are usually clad with plaster, increasing their size to 40-45 centimetres in section.

Figure 5.4.6 Contemporary concrete columns decorated with plaster

Contemporary type columns were found in the nontraditional part of the *transforming Thai house* (mainly in the bathroom) and the *reproduction Thai house* (usually at the ground level construction) (Figure 5.4.6). These columns were

typically plastered. Some columns were clad with stone and ceramic tiles inside the bathrooms.

5.4.2 Walls

Figure 5.4.7 (A) shows the traditional wall panels used only at the upper floor level. There is no wall at the ground level in the *traditional Thai house*. The upper level walls are modular units that can be quickly assembled. The panels can also be easily taken out, relocated and reassembled elsewhere. They are made for cladding the inclined columns. The panel is shaped with a wide base and a narrow top. Their width is about 3-3.5 metres at the base and about 2.8-3.3 metres at the top. The height of pre-assembled panels, ready to install, is approximately 3.0 x 3.0 metres (width x height) and about 3-6 centimetres thick.

Various types of wall panels were evident in the surveyed areas. The variety is mainly due to the wall infill. The main panels are Fa Pakon (tall rectangular grid timber infill), Fa Loog Fak (raised center timber infill), Fa Samruad (woven split bamboo infill), and Fa Khat Thae (bamboo infill). There are other panels that are not illustrated in this research, such as Fa Krachang Orn, Fa Sai Bua, etc. The wall frame is usually made of teak (Tectonal grandis).

Traditional walls of these types are often found in the old parts of the *transforming Thai houses* and the *reproduction Thai houses*. The traditional part of the *transforming Thai house* maintains the original walls of the *traditional Thai house*. The most common type of traditional walls is timber infill walls: Fa Pakon; and Fa Loog Fak. The first type is used slightly more than the second type. The bamboo infill walls, Fa Samruad and Fa Khat Thae, are found in a small number of houses. The residents in both villages explained that the traditional units, clad with woven bamboo infill walls, were typically kitchen units. This type of wall material allows more ventilation than the timber infill walls. However, many surviving kitchen units are currently used as a bedroom unit or store room. The function of the kitchen unit is found in the cooking spaces instead.

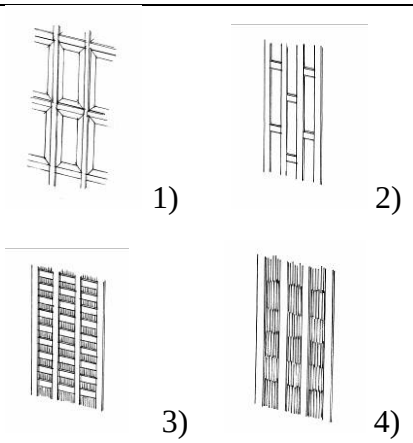
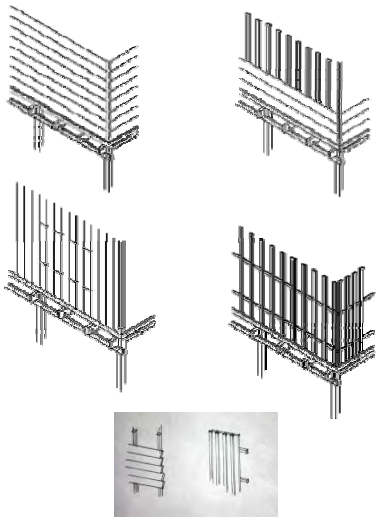
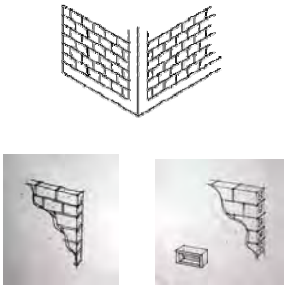
	Drawing	Description/size
A) Traditional	 1) 2) 3) 4)	1) Timber wall / Tall rectangular grid timber infill / Thickness: about 1.5-2.0 cm at the infill and about 5 cm at the stud 2) Timber wall / Timber stud and raised center infill / Thickness: about 2-2.5 cm at the infill and about 5 cm at the stud 3) Timber wall / Timber stud and grass or bamboo infill / Thickness: about 5 cm at the stud 4) Timber wall / woven split bamboo infill / Thickness: about 5 cm at the stud
B) Early Industrial	 1) and 2)	1) Timber weatherboard / Horizontal of vertical patterns / Cross section: 1-1.5 x 15 cm 2) Corrugated metal sheet / Vertical patterns / Length: 120-150 cm
C) Contemporary	 1) and 2)	1) Brick with plastering / Size: about 7 x 9 x 19 cm 2) Concrete block with plastering / Size: about 10 x 20 x 30 cm

Figure 5.4.7 Drawings of the wall in traditional, early industrial and contemporary groups

In the traditional parts of the *reproduction Thai house*, the upper level wall is similar to the archetype. Because the distance of floor to roof beam (approximately 3.5 metres) and the span of column (4-5 metres) increase from the traditional archetype, the walls are made with taller proportions. Although modern tools such as electrical saws and drills are used, the modular-panel walls are still built with traditional details, skills, and also strictly follow the traditional rule. All walls of the *reproduction Thai houses* in the buffer area are Fa Loog Fak type. The builders commented that this type of wall requires highly skilled workmanship. They also stated that these kinds of walls provides better protection and are more durable than the other types.

At the ground level, enclosed spaces are found in some nontraditional parts of the *transforming Thai house*s and in every *reproduction Thai houses.* Typically, the enclosed space is not built beneath the traditional part of the *transforming Thai house*.

Figure 5.4.7 (B) shows two types of wall in the EM group: timber weatherboards; and corrugated metal sheets. Weatherboards, applied vertically, are normally made of teak (about 1-1.5 x 15 centimetres in section). They are fixed to timber studs (about 2.5 x 7.5 centimetres in section) using nails. Corrugated metal sheets (about 120 x 120 centimetres) have long been very popular for cladding bathroom units to resist dampness but they are recently being replaced by masonry walls.

The walls in this group are found in both the traditional and the nontraditional parts of the *transforming Thai houses*. These walls are typically used only at the upper level. In the older or traditional parts of the *transforming Thai house***,** it was found that early industrial materials such as corrugated metal sheet are used as replacement walls for the traditional parts of the transformed house. One house in the urban district village used corrugated materials on three sides because of the lack of extended eaves. In another house in the rural village, the wall was partially replaced. The residents explained that the original wall was damaged by water leakage from a roof.

The walls of the non-traditional part of nearly every transforming Thai house are made of weatherboards. Weatherboards are applied in a mixed pattern with the vertical pattern at the upper level and a horizontal pattern on at lower section. The remaining weatherboard is applied horizontally while houses wholly clad with the vertical pattern are not found in the sample.

Corrugated metal sheets are used in some panels of the extensions and bathrooms. Bathrooms are commonly found at the upper level of the transforming house. The bathrooms are typically built of concrete and brick wall. Some bathrooms at the upper level in the rural village are still clad in corrugated metal sheets. The residents stated that the use of corrugated metal sheets at the bathrooms ended in the 1980s, when masonry walls become more common.

Figure 5.4.7 (C) shows two types of walls in the contemporary sampling: brick walls, and concrete block walls. Different from local bricks, these modern bricks are usually made in modern factory kilns. Bricks may be solid, cored, or hollow, manufactured in standard size (about 7 x 9 x 19 centimetres). Concrete blocks are used for some houses because their larger size (about 10 x 20 x 30 centimetres) can reduce the time and labor cost. From the interviews with the local builders, it is clear that some masonry walls are strengthened using reinforced bars and cement grout-filled joints. However, these walls are not load-bearing wall because the house structure relies on a post-and-beam system. Plaster is applied over the masonry. Decorated plaster began to be used very recently.

The contemporary walls are evident in the non-traditional parts of the *transforming Thai house* and the *reproduction Thai house*. The use of masonry walls is typical in many *transforming Thai house* and in every *reproduction Thai house*. The residents said that masonry walls could withstand moisture and were more durable than weatherboards or corrugated metal sheets. In the *transforming Thai houses*, the masonry walls are used to enclose spaces at the ground level. In the *reproduction Thai house*, the masonry walls are used in most of the construction at the ground level and the upper level bathroom.

5.4.3 Beams

Figure 5.4.9 (A) shows the traditional timber beam at the upper floor level. There are two types of beams in the *traditional Thai house*: an upper floor level beam and a roof tie beam. They both span between columns along the narrow side of the house. The data of the tie beams are discussed in the roof structure previously (see Sub-section 5.3.2). The ground level beam is not used in the *traditional Thai house*.

Because steps were used between the terrace, verandah and room, double beams were used between these three spaces. Beams (about 5x25 centimetres in

section) are made of the same timbers as columns. It is fitted into a mortise of a column with either end extending about 20 centimetres. Traditionally, beams received a solid floor plank without a secondary joist (Figure 5.4.8). In some cases, supporting beams were hung from the frame of wall panel to additionally support to prevent the floorboards from sagging.

Figure 5.4.8 Traditional beams and mortised columns

Figure 5.4.9 (B) shows two types of a timber beam in the early industrial group: beam fitted into a mortise with joists; and beams with joists. The first type of a beam is fitted into a mortise of a column the same as the traditional beam. Following scarcity of traditional timber, the floor plank thickness was reduced and joists were introduced to achieve required load capacity. The second type of a beam is widespread in the bungalow style houses with smaller size (approximately 5 x 20 centimetres in section) than the traditional beam. Joists (approximately 3.5 x 10 - 12.5 centimetres in section) are used to support a floorboard (about 3.5 centimetres in thickness), which are thinner than a floor board (approximately 5 centimetres in thickness) in the *traditional Thai house*s. Bolted connections replaced mortise-and-tenon joints to connect this beam with the column. Joists are placed on the beams and braced by timber brackets. Nails are used to fasten joists and floorboards.

The beams in this group are found in the nontraditional part of every *transforming Thai house*. These beams are made of timbers with joist-and-beam system and could be connected with timber or concrete columns. At the ground level of the construction constructed in the early industrial period, the area under a

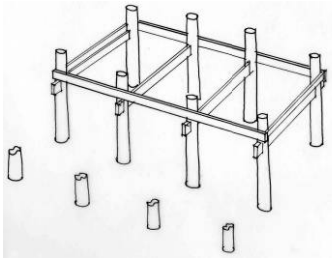
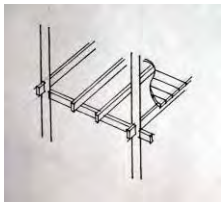
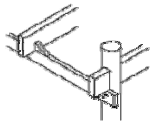
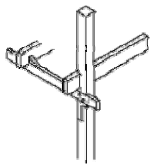
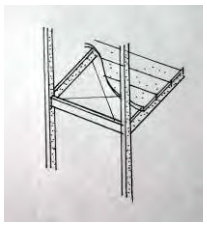
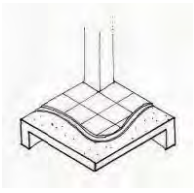
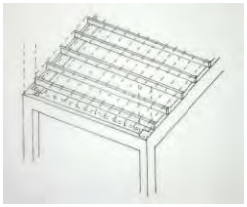
	Drawing	Description/size
A) Traditional		Timber beams with mortise-and-tenon joint/ Cross section: about 5-7.5 x 20-25 cm
B) Early Industrial	  a)   b)	Timber beams / Cross section of a beam: 5-7.5 x 20-25 cm and cross section of joist: 5 x 15 cm a) Mortise-and-tenon joint with joists b) Bolted joint with joists
C) Contemporary	 a)  b)  c)	a) In-situ cast concrete beams with precast concrete floors / Cross section of a beam: about 10-15 x 25-30 cm b) In-situ cast concrete beams with in-situ concrete floor / Cross section of a beam: about 10-15 x 25-30 cm c) In-situ cast concrete beams with timber joists / Cross section of a beam: about 10-15 x 25-30 cm

Figure 5.4.9 Drawings of the beam in traditional, early industrial and contemporary groups

raised floor was commonly an opening space similar to the area in the traditional house. This space was sometimes floored with a slab-on-ground concrete, which a beam is not required. However, enclosed spaces, floored with a slab-on-beam concrete, are found in a few houses.

Figure 5.4.9 (C) shows the concrete beams in the contemporary group. These beams are made of reinforced concrete, which is constructed to receive a precast concrete floor, an in-situ cast concrete floor or a timber floor. The size is 10-15 x 30-50 centimetres in section. There is no use of a precast concrete beam in the study locations.

The contemporary beams are found in the nontraditional part of the *transforming Thai house* and in both the traditional and nontraditional part of the *reproduction Thai house*. In the non-traditional part of the *transforming Thai house*, beams at the bathroom are mostly made of in-situ cast concrete. Only a few bathrooms at the upper level in the rural village are built with timber beams and joist-and-beam system.

In the traditional part at the upper level of the *reproduction Thai house*, the beam is different from the traditional archetype. From the samples in the buffer area, there are two beam systems: beam-and-joists system and beam and solid floor system. Beams of the first system support timber floor boards, fixed to timber joists placed between concrete beams. Because the structure of the ground level, from foundations to upper floor level beams, is concrete, the timber joists is on in-situ concrete beams spanning 4-5 metres. Beams of the second system are cast together with a concrete floor. The concrete floor is topped with concrete screed and timber battens (5 centimetres thick). After that, floorboards are laid on the battens. Most of the beams in the *reproduction Thai houses* are built with the first system.

5.4.4 Floors

Figure 5.4.10 (A) shows the traditional timber floor at the upper floor level. The floor is made of 5 x 40-50 centimetre (thickness x width) boards which are laid on the beams. The beams are fitted between mortised columns. The floor span is typically 2.8-3.5 metres. Without joists, the thick timber boards can firmly span between beams. An additional beam, held from the wall frame, is sometimes used to support the floor instead of a joist. Each floor board is joined by wooden dowels

(about 1 centimetre in diameter) or wedges (about 1 x 1.25 centimetres (thickness x length)). The floor boards inside a house are made of Teak (Tectonal grandis). At the terrace, floor boards are widely spaced with one centimetre gaps for rainwater drainage in order to prevent the floor from rotting. They are made of Teng (Shorea obtuse) or Rung (Shorea siamensis).

The traditional floors are found in the traditional part of the *transforming Thai house*. The original floorboards remain in many houses but most of the floorboards were additionally supported by joists. Some floorboards were initially built with beam-and-joist system. The wooden dowels or wedges for joining floorboards are still found in some houses. A step (30 centimetres) between the bedroom unit and verandah has been leveled by lifting the verandah floor up to the level of the bedroom unit floor. A few houses in Ladchado retain the steps though the gaps were sealed.

Figure 5.4.10 (B) shows three types of floor in the early industrial group: timber floors on joists and beams fitted into mortised columns; timber floors on joists and beams; and slab-on-ground concrete floor. The first and second type is similar at the joists but the beam fitting is different. The beam of the first type is fitted into a mortised column while the second type is placed beside a column and connected with bolts. Timber boards since the intermediate period have been thinner and need joists to prevent deflection. The size of the floor boards is 2.5-3.5 centimetres in thickness and 25-30 centimetres in width. The floor span is typically 1.0 metre. They are made of the same hardwood as the traditional floor. Nails were used to fasten the floorboards to the joists. The third type, a slab-on-ground concrete floor, is typically used for the ground floor of a house in the early industrial period. The concrete slab (about 10-13 centimetres thick) is built without beam.

The floors in this group are found in the nontraditional part of the transforming Thai house. The timber floor was lifted to the same level as the bedroom unit and verandah. A step between the lifted verandah and non-traditional part disappeared in most transforming houses.

Some areas of the living space or expansions at the upper floor level were typically built from the original timber floorboards from the central terrace. One centimetre gaps between floor boards were eliminated at the same time of reconstructing.

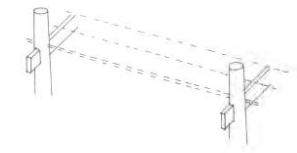
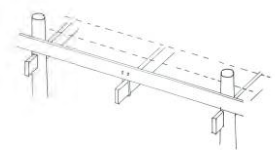
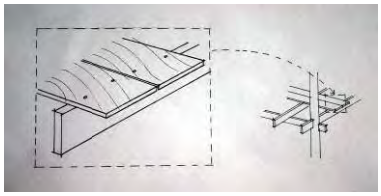
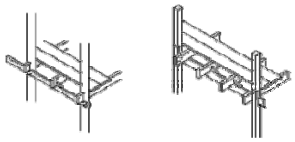
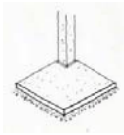
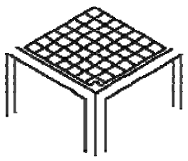
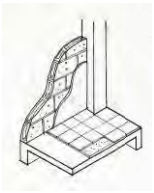
	Drawing	Description/size
A) Traditional	 1)  2)	1) and 2) Timber floorboards without and with supporting beams, hanged from wall frames / Cross section: about 3.5 x 30-50 cm
B) Early Industrial	 1)   2) 3)	1) Timber floorboards / Beam-and-joists system / Beams fitted between mortised columns / Cross section: about 2.5-3.5 x 25-30 cm 2) Timber floorboards / Beam-and-joists system / Bolt connection / Cross section: about 2.5-3.5 x 25-30 cm 3) Slab-on-ground concrete floors / Thickness: about 10-12.5 cm.
C) Contemporary	  1)   2) 3)	1) In-situ concrete floors / Clad with ceramic tiles, timber boards or stone tiles / Thickness: 10-15 cm 2) Precast concrete floors on in-situ concrete beam / Thickness: 10-12.5 cm / width: 40-80 cm 3) Timber floorboards on timber joists and in-situ concrete beams / Thickness: about 2.5-3.5 cm / width: 20-40 cm

Figure 5.4.10 Drawings of the floor in traditional, early industrial and contemporary groups

Some ground level floors are still compacted soil (37 houses from 71). The others are made of slab-on-ground concrete floor (34 houses from 71). The slab-on-ground concrete is commonly used for the internal road in the contemporary and the *reproduction Thai houses*.

Figure 5.4.10 (C) shows three types of floors in the contemporary group: in-situ cast concrete floors; precast concrete floors; and timber floorboards on timber joists and in-situ cast concrete beams. Both the in-situ cast and precast concrete floors (10-12.5 centimetres in thickness) are commonly used for contemporary houses inside and outside the surveyed locations.

The precast concrete floor is supported by in-situ cast concrete beams and columns. The precast floor is built with an array of narrow solid concrete slabs (40-80 centimetres in width), poured over with concrete screed (about 5 centimetres thick).The finishing is applied with ceramic tiles, terrazzo or tongued-and-grooved timber strips (about 2.5x10 centimetres in section). The third type is timber floorboards (about 2.5-3.5 x 20-40 centimetres in section), laid on timber joists and in-situ concrete beams.

The floors in this group are found in the nontraditional part of the *transforming Thai house* and every part of the *reproduction Thai house*. In the nontraditional part of the *transforming Thai house*, the in-situ cast concrete is commonly used for building a bathroom construction at the upper level. The floor is typically constructed all together with the beam and the column. This floor is finished by ceramic floor tiles. A few bathrooms at the upper level in the rural village are built with timber. The floorboards were laid with half centimetre gaps for drainage.

In the traditional part of the *reproduction Thai house* at the upper level, the timber floorboards were typically laid on timber joists, supported underneath with concrete beams. The size of the floorboard in some houses is similar to the one in the archetype. The floorboard of the other houses is narrower and slimmer (2.5-3.0 x 20-30 centimetres thick and width). There is a house built with floorboards (2.5 x 20 centimetres thick and width) placed on a solid floor. All floors in the samples are not traditionally joined by traditional wooden dowels or wedges.

In the nontraditional part at the ground level of the *reproduction Thai house*, the precast concrete floors are used only in one house. In the other houses, all floors are made of the in-situ concrete. The residents stated that the in-situ cast concrete floor is more durable than the precast concrete floor.

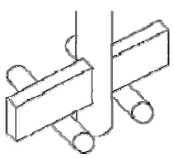
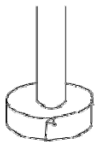
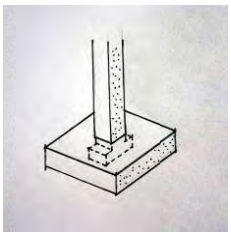
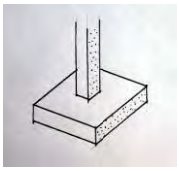
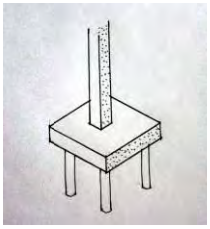
	Drawing	Description/size
A) Traditional	 1)  2)	1) Timber footing / 1-2 beams on top of logs / Diameter: 15-20 cm and cross section 5 x 15 cm 2) Timber footing / Flat circular shape / Diameter: 30-40 cm and thickness: 5-7 cm
B) Early Industrial		Reinforced concrete footing / With or without shallow piles (timber or concrete piles) / In-situ casting connected with precast concrete or square timber columns / Size: 60 x 60 cm -100 x 100 cm
C) Contemporary	 1)  2)	1) Reinforced concrete footing / In-situ casting with in-situ cast concrete columns / With or without shallow piles / Size: 60 x 60 cm-100 x 100 cm 2) Reinforced concrete footing / In-situ cast with in-situ cast concrete columns / Deep concrete piles / Size: 80 x 80 cm-120 x 120 cm

Figure 5.4.11 Drawings of the foundation in traditional, early industrial and contemporary groups

5.4.5 Foundations

The foundation is the only element that could not be observed. In the study, the information is drawn from interviews with the local builders and residents. Similar to the ground level column, the timber foundations of the *traditional Thai house* need

Figure 5.4.11 (A) shows three types of shallow foundation in a traditional to be regularly repaired or replaced because of damage from floods and termites group: a two-log footing; a four-log footing; and a flat footing. The first and second types are built by round timbers (50-70 centimetres in length and about 15 centimetres in diameter), placed at the base of each column. The column base is mortised to receive the beam which transfers the loading of the dwelling to footing. The first type is built by one beam and two round timbers and the second type is built by two beams and four round timbers. The third type is simplest and easy to construct. A flat circular piece of timber (5 x 7 centimetres in thickness and 30-40 centimetres in diameter) is placed at the bottom of the post-hole. The timber foundation is generally made of Thong Lang (Erythina orientalis) (Jaijongrak 2000).

The traditional foundations are found both in the traditional part and the nontraditional part of the *transforming Thai houses*. In many houses, damaged footings have been repaired or replaced with traditional timber footings or concrete footings. The houses, whose footings are still in good condition, are the ones where the footings were changed when the dwelling was relocated during the last two decades. According to the interviews, some were replaced with concrete but most were repaired or replaced with timber.

Figure 5.4.11 (B) shows the foundation in the EI group, which is an in-situ cast concrete footing with a precast concrete or square timber column. This foundation is found with short concrete or timber piles (3-6 metres) or without piles. The size of a footing is about 60-100 x 60-100 centimetres.

The foundations in this group are found both in the traditional part and the nontraditional part of the *transforming Thai houses*. In the traditional part of the *transforming Thai houses*, concrete footings are used for the replacement of damaged traditional footings described previously. These footings are built to connect with the timber columns about 30-40 centimetres above ground level.

In the nontraditional part of the *transforming Thai houses*, concrete footings are typically used. Most houses are built with precast columns under a living space

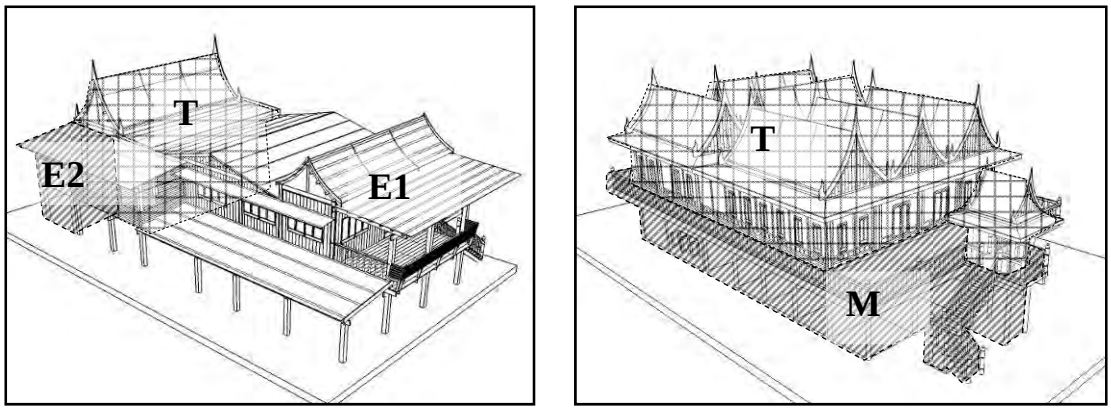
and in-situ cast columns under a bathroom. The concrete footings at the bathroom are categorized in the contemporary group.

Figure 5.4.11 (C) shows a shallow foundation and a deep foundation in the contemporary group. The size of these footings is about 60-100 x 60-100 centimetres and about 80-150 x 80-150 centimetres respectively. The piles of a deep foundation are normally 18 to 23 metres in length, which is the base of competent soil in central Thailand. For the shallow foundation, short wood or precast concrete piles (about 3-6 metres in length and 15 centimetres in diameter) are used. Driven piles are typically used in the buffer area but drilled piles are found in a few houses.

The contemporary foundations are found in the nontraditional part of the *transforming Thai houses* and the *reproduction Thai house*. Shallow foundations are used with a construction of a bathroom of the *transforming Thai house* while deep foundations are used in whole parts of the *reproduction Thai house*.

Driven piles are typically used with the *reproduction Thai houses*. The only house constructed with drilled piles is located close to neighboring houses. The residents said that they had to reduce the damage which may effects nearby houses during foundation works using drilled piles because of the vibrations of a pile-driver.

There were no preservative works for timber in most of the construction elements of the *transforming Thai house*. Carpenters specified timber such as teak which is naturally durable species if house owners had enough budgets. The lifetime of timber used with the vernacular houses is up to the house location and termite zone. The upper level construction elements such as roof structure, columns, and beams generally last longer than 80-100 years. However, the ground level construction elements such as foundations and columns were regularly repaired or replaced every 5-10 years. At present, carpenters usually recommend villagers to use chemicals to avoid decay and provide protection against termites.



(a) (b)

Figure 5.5.1 Main parts of two types of the vernacular houses (a) Existing traditional part (T), extension parts (E1), and recent extension parts (E2) of the transforming Thai house (b) Traditional part (T) and modern part (M) of the reproduction Thai house

Table 5.5.1 Conclusion of the typical feature of 7 construction element

	Parts of Transforming Thai house			**Parts of Reproduction Thai house**	
	Traditional Part	**Extension Part**	**Recent Extension Part**	**Traditional Part**	**Modern Part**
Roof Cladding	EI	EI	EI	T	C
Roof Structure	T	EI	EI	T	C
Columns	T	EI	C	T	C
Walls	T	EI	C	T	C
Beams	EI	EI	C	C	C
Floors	T	EI	C	C	C
Foundations	T	EI	C	-	C

Key: T=Traditional, EI=Early industrial, and C=Contemporary

5.5 Conclusion

The results of this chapter reveal developments of 11 construction elements of the *transforming Thai houses* and the *reproduction Thai houses*. These elements are able to be summarized into 7 construction elements (Table 5.4.1 and Figure 5.4.1). The *transforming Thai house* is separated into three main parts (existing traditional, extension, and recent extension). The *reproduction Thai house* is divided into two main parts (tradition at the upper level and modern at the ground level).

Early industrial features are commonly used at the extension parts of the *transforming Thai houses*. Contemporary features are typically used at the modern part (or ground floor construction) of the *reproduction Thai houses*. Traditional features are still found at the existing traditional part of the *transforming Thai house* except at the roof cladding and upper level beams. The *reproduction Thai houses*, which are newly built, present traditional features at the second floor construction.

These data develop an understanding of the change of use of materials and construction methods. This will be further analyzed with quantitative data in Chapter 6. The changing features of construction elements for five main transformations will be discussed. In addition, there will be two data comparisons: 1. the features and periods of the changing construction elements will be compared with their structure and cladding among the three locations; 2. the typical features of the transforming houses will be compared with the reproduction house.

Chapter 6
Changing Features of Construction Elements

6.1 Introduction

This chapter aims to discuss those findings from Chapters 4 and 5 in order to develop a better understanding of the use of materials in the construction on Thai vernacular houses. The quantitative data of the *traditional Thai houses* and contemporary Thai vernacular houses are shown and compared through various drawings of house groupings. These are arranged chronologically and presented by pie charts, time-scale charts and tables of comparison.

In this study, the term “type” is used in this chapter to signify the combination of materials and construction methods used for a construction element. The term “feature” denotes the most typical type and relates to physical appearance (including form and shape) of particular parts of the surveyed building. Each feature can be combined from various types of materials and construction methods. Accordingly, “feature” means the dominant or overall type of the construction elements in each transformation. In this chapter, the term “intermediate” is used to indicate a type or feature in place of “early industrial”, which is applied with materials or construction methods.

This chapter begins with the discussion on the changing features of construction elements for five main transformations are discussed in Section 6.2. In Sections 6.3 and 6.4, the features and periods of the changing construction elements (the roof and the elements under the roof) are discussed and compared with their structure and cladding among the three studied locations. In Section 6.5, the typical features of transforming and reproducing houses are compared. The opinions of residents about the changes are also shown in Section 6.6.

However, some of the surveyed houses do not include in a sample because of missing required information. Therefore, there are selected 23 houses in the urban district villages and 31 houses in the rural villages for the analysis of transformation in Section 6.2. Eight houses in the buffer areas are included for the comparison among three locations in Section 6.3 to 6.6.

6.2 Features of the main changes

As discussed in Sections 5.3 to 5.5, not only the space, form and lay-out of vernacular Thai houses but also their construction elements have changed. Since this research is aimed at understanding the relationship between the changing features and the transformations, the type of eleven construction elements are discussed according to the five main physical transformations which have occurred in *transforming Thai houses*.

The most dominant features in the surveyed houses are presented in the tables. The groups of features are traditional, intermediate (or early industrial (EI) when used with materials), and contemporary. The numbers of houses with the most dominant features are shown in order to find the relationships. The location data are divided into urban district and rural villages.

6.2.1 Central terraces to halls

In Chapter 4, besides the limited land area surrounding the house, a central terrace was transformed into a hall because the residents needed more internal spaces, privacy and security. Most of the residents reported various changes in lifestyle which meant more internal space was required. In Table 6.2.1, the results of the study suggest that the features of the central terrace are similar to the features of the whole *transforming Thai house.*

The intermediate features are the most dominant in this change, both in the urban district and the rural areas. The intermediate features have been combined with the *traditional Thai house* at the central terrace to create a hall, the single largest part of the *transforming Thai house*. For bungalow-style constructions, timbers were used with modern methodologies and functional orientation.

The bungalow style roof covers a larger area of the central hall than the bedroom unit of the *traditional Thai house*. The span of the traditional Thai roof is limited to approximately 3.0 to 3.5 metres. The low-angle form of the bungalow-style roof, connected to the high pitched roof of the *traditional Thai house*, creates one continuous space inside the house. The bungalow style roof is more economical because of its compactness, simple form and lower cost of maintenance. The low-angle truss-technique structure minimizes the use of materials both for structural elements and gable cladding.

Table 6.2.1 Features of construction elements: hall

Features (Number of houses)			
	Traditional	**Intermediate**	
	Rural	**Urban D.**	**Rural**
1. Roof cladding	-	15	24
2. Roof structure	-	15	24
3. Upper column	-	15	24
4. Upper wall	-	15	24
5. Upper beam	-	15	24
6. Upper floor	-	15	24
7. Foundation	24	15	-
8. Ground column	18	15	6

Keys:

-Ground = Ground level, Upper = Upper level

-Urban D. = Urban District

-15 of the 23 houses in the urban district village and 24 of the 31 houses in the rural village have had their central terraces transformed into halls.

Corrugated materials reduce maintenance work and leaking problems compared to clay tiles and thatch. Although the cost of new roofing is higher than traditional roofing, corrugated materials reduce the cost of roof maintenance or replacement for residents later on.

The other construction elements were mostly built of timber but using early industrial methods, which reduced the cost of employing a highly skilled builder. Instead of using non-traditional materials such as concrete-based materials, local builders were familiar working with timbers even though the shape, form and technique of house construction have changed. The intermediate type could be used to cover a traditional central terrace and required minimal adjustments. The only significant difference between the rural and the urban district villages was the use of the traditional type of foundations in the countryside. For economic reasons, rural residents preferred to repair or replace them with timbers because of the greater availability of timber, and the cheaper labor compared to the urban district village.

The purpose of changing a multi-level floor into a flat level floor was to create a large interior space without steps. A flat level floor was built with smaller sized

timbers than the traditional floor because of the introduction of a joist and beam system. The non-traditional floor could share its structure with the existing traditional beams and columns. Therefore, a flat level floor provides economical benefits when built in the intermediate type.

The evidence from both the physical development of the construction elements and residents' opinions suggests that function, durability and economics are the main reasons for the use of a bungalow style roof and a single flat level floor for the hall.

Table 6.2.2 Features of construction elements: enclosed space at ground level

Features (Number of houses)			
	Intermediate	**Contemporary**	
	Urban D.	**Urban D.**	**Rural**
1. Foundation	4	6	1
2. Ground column	4	6	1
3. Ground wall	-	10	1
4. Ground beam	-	10	1
5. Ground floor	-	10	1

Keys:

-Ground = Ground level, Upper = Upper level

-Urban D. = Urban District

-15 of the 23 houses in the urban district village and 24 of the 31 houses in the rural village have had their central terraces transformed into halls.

6.2.2 Area under raised dwellings

The need of residents for more internal space has encouraged the transformation not only of the upper floor, but of the ground floor as well. The frequency of enclosed spaces at the ground level is related to the probability of flooding in the areas. The urban area of the urban district village has a higher number of houses with enclosed spaces at the ground level than the rural area of the rural village. There has been no flooding in the urban district village since 1996 and in some areas of the rural village since 2004.

Household activities under the raised floor of the building still mostly occur outside the enclosed space. Therefore, the areas of these enclosed spaces are rather

small in both the urban district village and the rural village (about 20% of the whole ground level area) compared to the buffer area (about 55% of the whole ground level area). In Table 6.2.2, all the enclosed spaces have been typically built in the contemporary type (concrete structures and masonry walls), even though the cost of building is higher than the intermediate type.

The residents stated that the materials used in contemporary houses can withstand damp better than other materials. The concrete structures and masonry walls were built separately from the existing structure, namely the ground level columns and the foundations. Some enclosed spaces in the urban district village were built at relatively low cost by using existing early industrial columns and foundations as structures. The information from both the physical development of the construction elements and the residents' opinions demonstrates that the use of the contemporary type is mainly for reasons of long life of materials and durability.

6.2.3 Disappearance of a verandah and erection of a porch

A porch provides a transitional space at the front of the *transforming Thai house*. This is different from modifying a central terrace into a hall. Porches are entirely extended from the front of the enclosure at the upper floor level. Roofs covering the porches are larger than the verandah of the *traditional Thai house*. In Table 6.2.3, the intermediate type is used mainly with bungalow style and low-angle roofs. However, there are a few porches that were constructed in the traditional type and with high-pitch roofs.

The low-angle roof structures and corrugated roofing materials lower the costs of both maintenance and construction. Similar to the hall, the traditional columns and foundations at the ground level show the difference between the urban district and rural villages. The information from both the physical development of the construction elements and residents' opinions shows that the use of intermediate type here is mainly for reasons of durability and cost.

Table 6.2.3 Features of construction elements: porch

Features (Number of houses)				
	Traditional		**Intermediate**	
	Urban D.	**Rural**	**Urban D.**	**Rural**
1. Roof cladding	-	-	16	25
2. Roof structure	3	4	13	21
3. Upper column	3	4	13	21
4. Upper beam	-	-	16	25
5. Upper floor	-	-	16	25
6. Foundation	-	15	16	10
7. Ground column	-	15	13	10

Keys:

-Ground = Ground level, Upper = Upper level

-Urban D. = Urban District

-15 of the 23 houses in the urban district village and 24 of the 31 houses in the rural village have had their central terraces transformed into halls.

6.2.4 Bathrooms at the upper level

Bathrooms have been built at the upper level because of the residents' need for sanitation, convenience, and privacy. In Table 6.2.4, the results show that a bathroom is obviously the most modernized construction in the *transforming Thai house*. Except for the roof, the construction elements are built with concrete structures and masonry walls. Plaster and ceramic tiles are applied to the floors and walls.

Concrete structures are built separately from the intermediate or traditional type constructions. The information shows that the use of contemporary type construction here is mainly for reasons of durability and function.

6.2.5 Kitchen units to cooking space

The kitchen units have been merged with the house for the residents' convenience and because of the limited size of the land plot. Residents explain that the problem of the flammable thatch roofing was solved by using corrugated roofing. However, because of the unaffordable construction costs, few residents built their

Table 6.2.4 Features of construction elements: upper level bathroom

Features (Number of houses)					
	Traditional	**Intermediate**		**Contemporary**	
	Rural	**Urban D.**	**Rural**	**Urban D.**	**Rural**
1. Roof cladding	-	13	22	2	4
2. Roof structure	-	13	22	2	4
3. Upper column	-	-	3	15	23
4. Upper wall	-	-	3	15	23
5. Upper beam	-	-	1	15	25
6. Upper floor	-	-	1	15	25
7. Foundation	1	-	9	15	16
8. Ground column	1	-	2	15	16

Table 6.2.5 Features of construction elements: cooking space

Features (Number of houses)					
	Traditional	**Intermediate**		**Contemporary**	
	Rural	**Urban D.**	**Rural**	**Urban D.**	**Rural**
1. Roof cladding	-	16	29	-	-
2. Roof structure	-	16	29	-	-
3. Upper column	-	12	27	4	2
4. Upper wall	-	12	27	4	2
5. Upper beam	-	12	27	4	2
6. Upper floor	-	12	27	4	2
7. Foundation	18	12	11	4	2
8. Ground column	18	12	11	4	2

Keys:

-Ground = Ground level, Upper = Upper level

-Urban D. = Urban District

-Highlighted data show the most typical feature of the elements.

-16 of the 23 houses in the urban district village and 29 of the 31 houses in the rural village had cooking spaces constructed at the upper level.

cooking space in the contemporary type, using materials with suitable fire protection qualities.

The results in Table 6.2.5 show the features of the cooking spaces, which are similar to those of the halls and porches. Most of the cooking spaces were built in the intermediate type, with timber constructed in the bungalow style and using modern method. The traditional columns and foundations at the ground level show the main difference between urban and rural areas. The residents in the rural areas explained that they could afford to reuse timber brought from other provinces. However, price of the reuse timber is more expensive than modern materials since the late 1990s. So, they have changed to use other materials after that period. The information shows that the uses of the intermediate type in the cooking space are mainly for economic.

6.3 Features and period of the roof: Comparison of roof structure and cladding

The data of the features are presented as percentages in pie charts. The differences between each specimen are compared among three surveyed locations. For the roofing construction, the analysis is drawn from the appearances of two groups of construction elements: the cladding and structures.

The time-scale charts present the number of houses for each period of construction. The charts illustrate the beginning period of nontraditional (intermediate and contemporary) features. The years presented in the charts represent the date when the nontraditional features in each construction element first began. This chart is based on the information from 62 samples of vernacular houses in the studied areas. Two locations, the urban district village and the rural village, are in villages and another location, which is in the buffer area along a motorway. The data on the features and periods are discussed, with a comparison of the roof cladding and structure. The percentages are presented in three full-detail tables (Tables 6.3.1 to 6.3.3).

From Figure 6.3.1 A, the roof cladding in the group of traditional houses is found in a small number of cases in the *transforming Thai houses* in the urban district village (4.9%) and the rural village (1.5%). This traditional roofing uses clay tiles. As discussed earlier in Section 6.2, some of the construction elements of the *traditional*

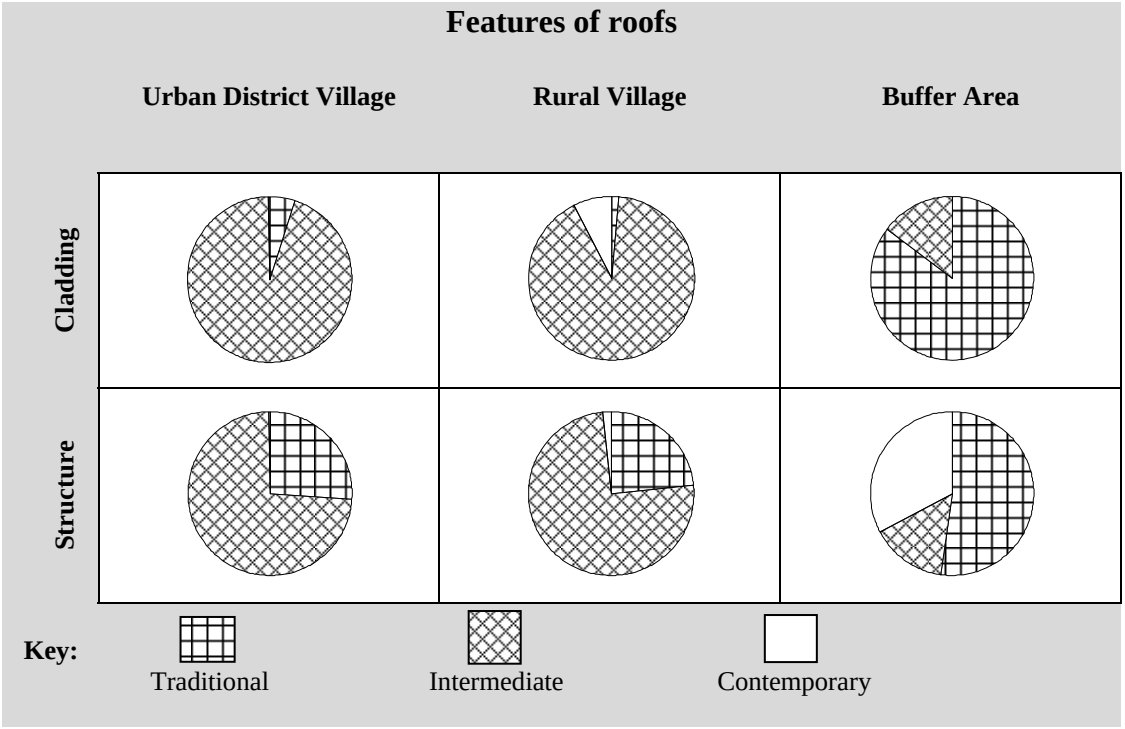
Thai house remain in the *transforming Thai house*: 25.1 % in the urban district village and 19.1 % in the rural village. However, clay tiles are widely used for the roofs of the *reproduction Thai houses* in the buffer area.

These data suggest that clay tiles used in traditional parts of the transforming houses have mostly been replaced by corrugated materials. Corrugated materials were frequently used for the roofs of the *transforming Thai houses* in both villages. Contemporary features are rarely found in the urban district village (0.3%) and the rural village (7.4%) and not found in the buffer areas of the motorway. This indicates that the roofs of most houses in the urban district village and the rural village have not changed since corrugated materials became popular in the intermediate period. Other materials are local concrete tiles and corrugated metal sheets. The corrugated tiles are still produced and commonly used for vernacular Thai houses.

The houses in the urban district village and the rural village differ in their use of roof cladding. In the traditional group, clay tiles are used more frequently in the urban district village than in the rural village. In the intermediate group, the use of corrugated concrete tiles is also more widespread in the urban district village than in the rural village. On the other hand, local concrete tiles and corrugated metal sheets are more commonly found in the rural village. In the contemporary group, modern concrete tiles also feature more regularly in the rural village than in the urban district village.

The features of the roof structures in the urban district village and the rural village mostly belong to the intermediate group, with various types of timber used. In the urban district village and the rural village, teak is the most important material for traditional structures, while Teng is mostly found in intermediate structures. Various timbers are used in the intermediate group.

There are very few contemporary features in both villages (0.3% and 1.8% respectively). There are some uses of steel (light-gauge) for reproducing traditional roofs, usually in Ayutthaya, but this occurs outside the surveyed locations. However, in the buffer area, only Teak and Teng are used to build traditional roof structures. Concrete is applied for building a flat roof, which can function as a terrace. This indicates that residents and builders are very conservative in choosing features for a pitch roof but more flexible in their use of a contemporary roof form.

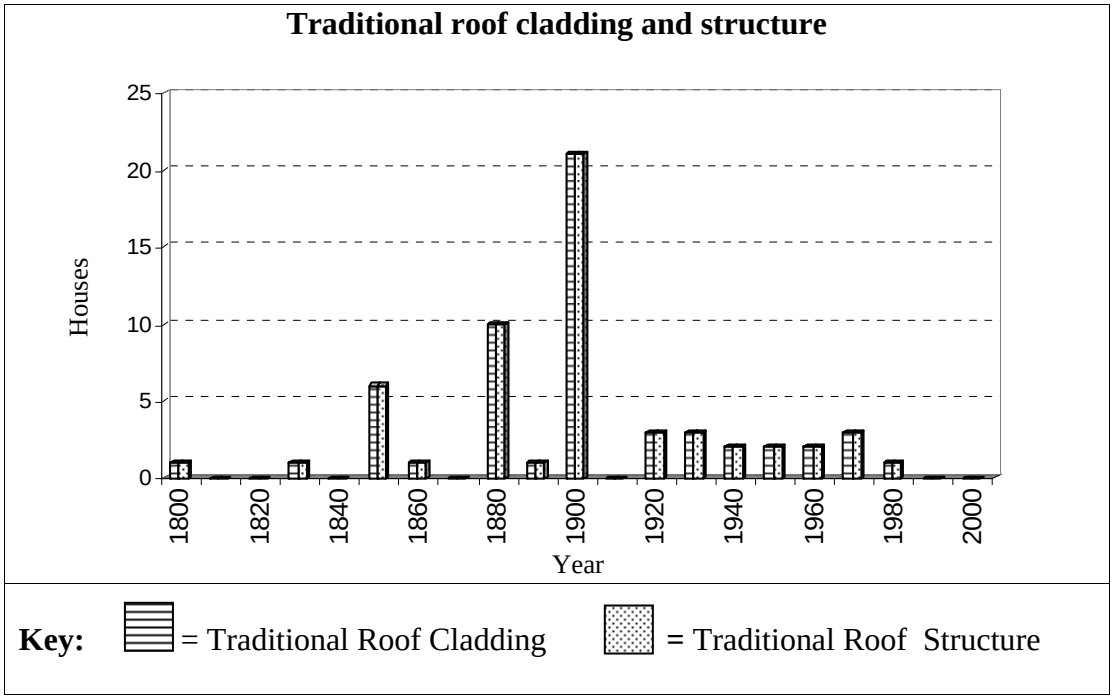


Note: The data are the averaged area of surface used in samples.

Figure 6.3.1 Features of the roof cladding and structures in the three surveyed locations

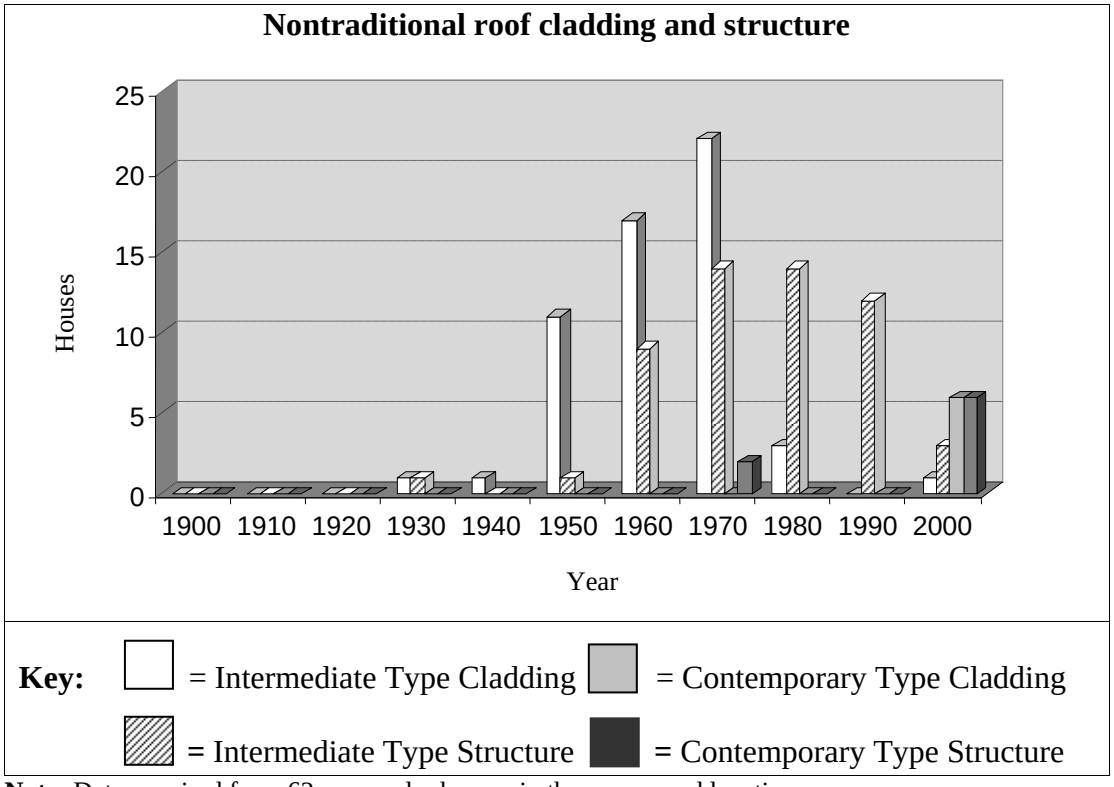
The beginnings of nontraditional features relates to the periods of construction of the original traditional dwelling, later merged or extended to form the transforming houses. Most houses in the study were built during in the 1850s, 1880s and 1900s (see Appendix B). According to the interviews, it appears that the houses from the 1850s and 1880s were mostly built in the rural village, while those from the 1900s were mostly built in the urban district village. Most roofs in the urban district village were first built with clay tiles. By contrast, many residents in the rural village explained that thatch was originally used and replaced with clay tiles after the 1900s.

In Figure 6.3.2, the intermediate group show the changes in use from thatch or clay tiles to corrugated materials in the 1930s, becoming most common from the 1950s to 1970s. This change was because of a big fire in the rural village in 1938 that subsequently encouraged modification in many houses with bungalow shaped roofs. The residents stated that the fires spread rapidly to the houses, particularly those with thatched roofs, and damaged more than a hundred homes. Afterwards, the residents were worried that another fire might happen again. Thus, corrugated materials for the roofs were chosen to ensure the fire protection and durability of the new houses.



Note: Data acquired from 54 transforming Thai houses in two surveyed locations: the urban district and rural villages

(a)



Note: Data acquired from 62 vernacular houses in three surveyed locations

(b)

Figure 6.3.2 The beginnings of traditional features (a) and nontraditional features (b) at roof cladding and structures

Most of the residents in the urban district village stated that the roof cladding of their house was initially clay tiles. A few residents (3 out of 23 households) indicated that the roofing material of their houses was thatch before being changed to clay tiles. The interviews indicated that clay tiles began to be used in the reign of King Rama 3rd in the 1840s. However, the residents were familiar with thatch roofs because of the continuity of using this material for their field shelters and rice barns.

The introduction of corrugated materials increased the period between roof cladding replacements. The residents in the urban district village and the rural village stated that thatch had to be replaced every three to five years. Although clay tiles might last for more than 10 years, they could be easily damaged from strong wind. They also estimated that corrugated metal sheets could last for at least 10-15 years, and corrugated concrete tiles for 20-25 years. In the urban district village, there are two transforming houses that started using imported metal sheeting for the eaves from the time of their construction in the 1900s. When these corrugated materials started to be produced in Thailand in the 1930s, the use of this material expanded to the entire roof structure and walls of many houses. The use of corrugated materials was popular from the 1950s to the 1970s.

The first use of contemporary roofing was around about the beginning of the 21st century. Because clay tiles with color coating (used in contemporary architecture) are categorized in the traditional group, flat-slab concrete is considered contemporary roofing and is found mainly in the buffer area. This shows that contemporary concrete tiles have not been used so far as a replacement of intermediate or traditional materials within the samples.

In the intermediate group, roof structures have appeared in significant numbers since the beginning of the 1960s, while roof cladding was used at the beginning of the 1950s and noticeably reduced after the 1970s. The replacement of roof cladding was found earlier than the replacement of structures for *transforming Thai houses*. The re-cladding of the roof was initially undertaken for replacement but the subsequent erection of the structure was for expansion. This shows that the features of replacements are more easily changed than the features of new constructions.

In the buffer area, contemporary roof structures have recently appeared in the form of a flat roof. This concrete flat roof is necessary for the *reproduction Thai house* because of the new layout of roofs and terraces at the upper level of the house.

Table 6.3.1 Percentage of features appearing in three groups (At the roof cladding and roof structures in three surveyed locations)

Roof Cladding and Roof Structures				
Groups of features		**Urban district village**	**Rural village**	**Buffer area**
T	**CL**	4.9%	1.5%	83.7%
	ST	26.0%	23.2%	52.1%
I	**CL**	94.8%	91.1%	16.3%
	ST	73.7%	75.0%	15.2%
C	**CL**	0.3%	7.4%	0%
	ST	0.3%	1.8%	32.7%

Note: CL=Cladding, **ST=**Structure

Table 6.3.2 Percentage of uses of each material cladding in three groups (At the roof in three surveyed locations)

Roof Cladding					
Period Group/Materials		**Urban district village**	**Rural village**	**Two villages**	**Buffer area**
T	a) Thatch	0%	0%	0%	0%
	b) Clay tiles	4.9%	1.5%	3.0%	0%
	c) Ceramic tiles	0%	0%	0%	83.7%
	Total	4.9%	1.5%	3.0%	83.7%
I	a) Local concrete tiles	6.5%	10.3%	8.8%	0%
	b) Corrugated metal sheets	8.7%	18.8%	14.4%	0%
	c) Corrugated concrete tiles	79.6%	62%	69.4%	16.3%
	Total	94.8%	91.1%	92.6%	16.3%
C	Contemporary concrete tiles	0.3%	7.4%	4.4%	0%
	Total	0.3%	7.4%	4.4%	0%

Table 6.3.3 Percentage of uses of each material in three groups of features (At the roof structure and three surveyed locations)

Roof Structures					
Period Group/Materials		**Urban district village**	**Rural village**	**Two villages**	**Buffer area**
T	Timber - Teak - Teng	 26.0% 0%	 23.2% 0%	 24.4% 0%	 43.4% 8.7%
	Total	26.0%	23.2%	24.4%	52.1%
I	Timber - Daeng - Teng - Mahogany - Eucalyptus - Pine	 16.2% 21.1% 18.6% 11.5% 6.3%	 12.7% 38.5% 23.8% 0% 0%	 14.2% 31.1% 21.6% 2.7% 4.9%	 6.3% 8.9% 0% 0% 0%
	Total	73.7%	75.0%	74.5%	15.2%
C	a) Light-gauge steel b) Concrete slab	0.3% 0%	1.8% 0%	1.2% 0%	0% 32.7%
	Total	0.3%	1.8%	1.2%	32.7%

6.4 Features and period beneath the roof: comparison of structures and cladding

The data of the construction beneath the roof are presented and discussed using the same method as the one in Section 6.3. At the upper level construction, there are four construction elements: columns, walls, beams, and floors. At the ground level construction, there are five construction elements; foundations, columns, walls, beams, and floors. Three elements (walls, beams, and floors) at the ground level are found only in recent construction, while these did not appear in traditional construction.

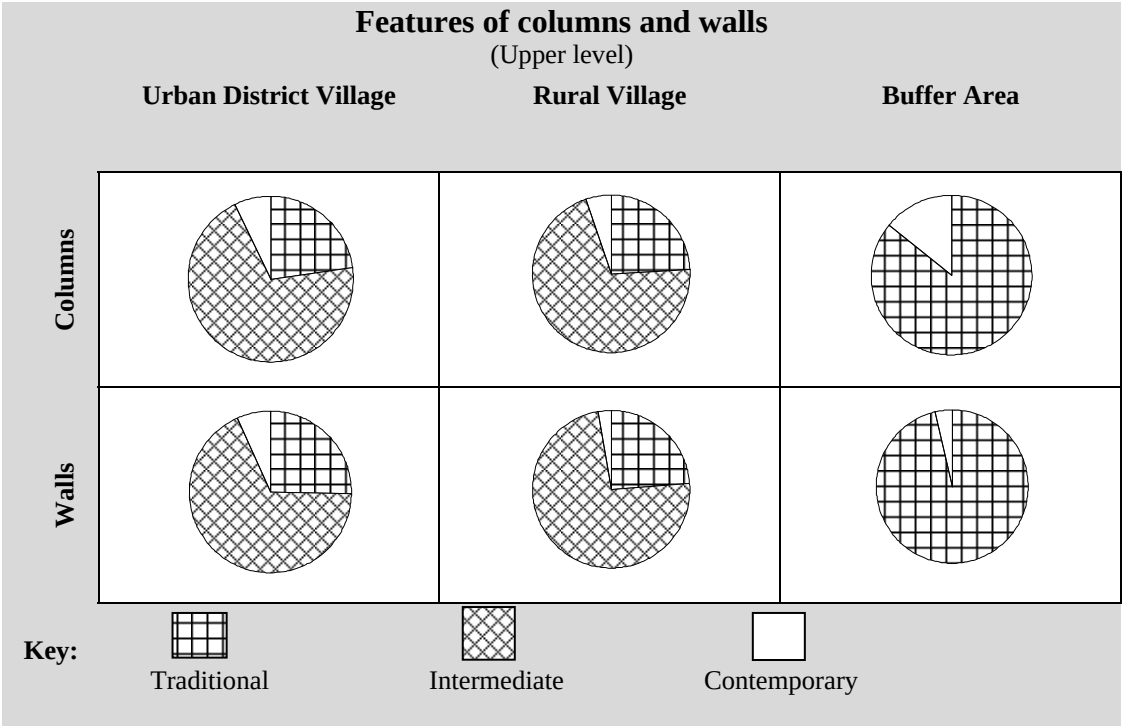
The data are discussed in pairs of structures and claddings: 1. upper level columns and walls; 2. upper level beams and floors; 3. ground level columns and walls; 4. ground level beams and floors. In addition, the discussion compares the differences between the upper level and the ground level. However, foundations are discussed individually. The percentages are presented in 11 full-detail tables (Tables 6.4.1 to 6.4.11)

6.4.1 Upper level columns and walls

From Figure 6.4.1, the highest percentage of traditional columns is found in the buffer area and Teng is the most used timber. The data show significantly greater numbers of traditional timber columns in the *reproduction Thai house* than in the *transforming Thai house*. By contrast, traditional columns are not found in the extension of the *transforming Thai house*. The residents restrict the uses of the traditional columns to only the traditional parts of the house.

The features of the intermediate group are most commonly found in the urban district village (70%) and the rural village (70.6%). They are mainly a simple square-shaped timber column with bolted connections. These are always used for the expansions of the transforming house. Teng is the most commonly used timber and is similarly found in the urban district village and the rural village.

The features of the contemporary group are found infrequently because in-situ cast concrete is typically used for bathroom construction. In the buffer area, these appear in a higher proportion because there is more widespread use of in-situ cast concrete columns for bathrooms, cooking areas and storage.



Note: The data are the averaged area or amount of samples.

Figure 6.4.1 Features of the upper level columns and walls in three surveyed locations

In the urban district village and the rural village, the appearances of the columns at the upper level are mostly similar. There is a slight difference between these two locations. In the traditional group, teak is the most popularly used and found much more than other timbers in the urban district village. Teng is the most typical timber in the rural village, but found only slightly more frequently than the uses of teak. Rung and Makha are found only in the rural village while Daeng is found only in the urban district village.

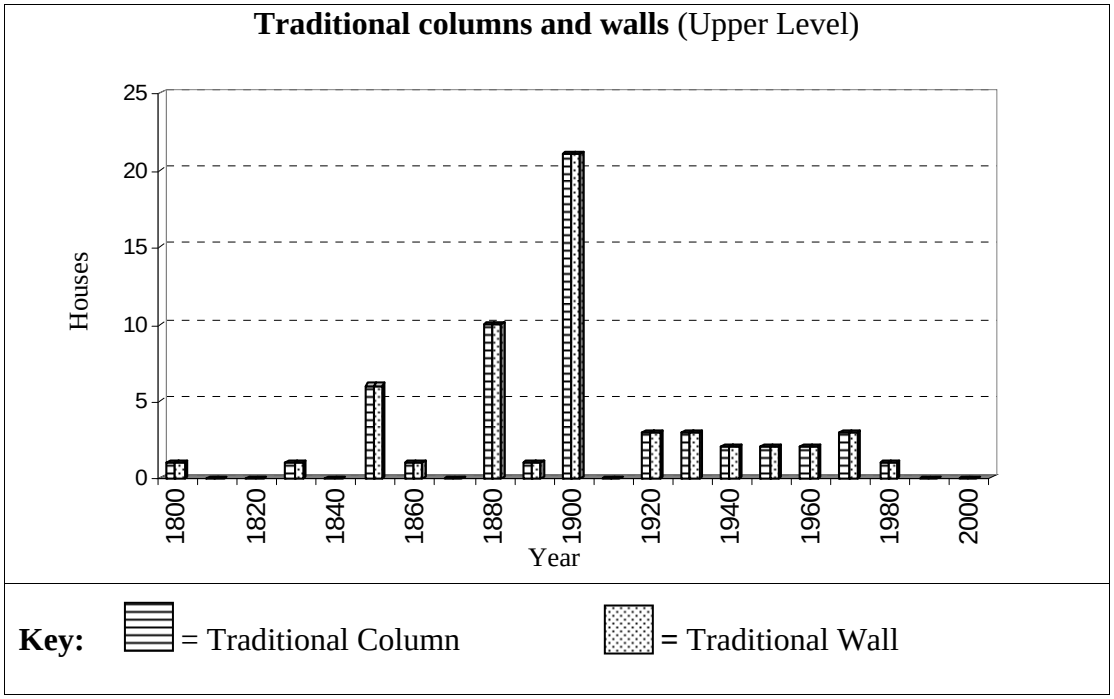
In the intermediate group, teng is the most used timber. There are no uses of teak in both locations and no uses of eucalyptus and pine in the rural village. Only a few steel columns are found in the urban district village. In the contemporary group, only in-situ cast concrete is found in similar proportion in both villages.

Traditional walls are used for almost every part of the upper level in the buffer area (96.5%). However, some walls are constructed with concrete structures inside, which are mainly built for the bathroom. Builders in the buffer area seem to keep the appearance of the upper level construction in the traditional type, with excellent details.

At the upper level, the appearance of walls in the urban district village and the rural village are mostly similar. There are a few differences between these two locations. In the early intermediate group, the only use of corrugated metal sheets is in the urban district village. In the contemporary group, the only use of concrete blocks with plaster is also in the urban district village.

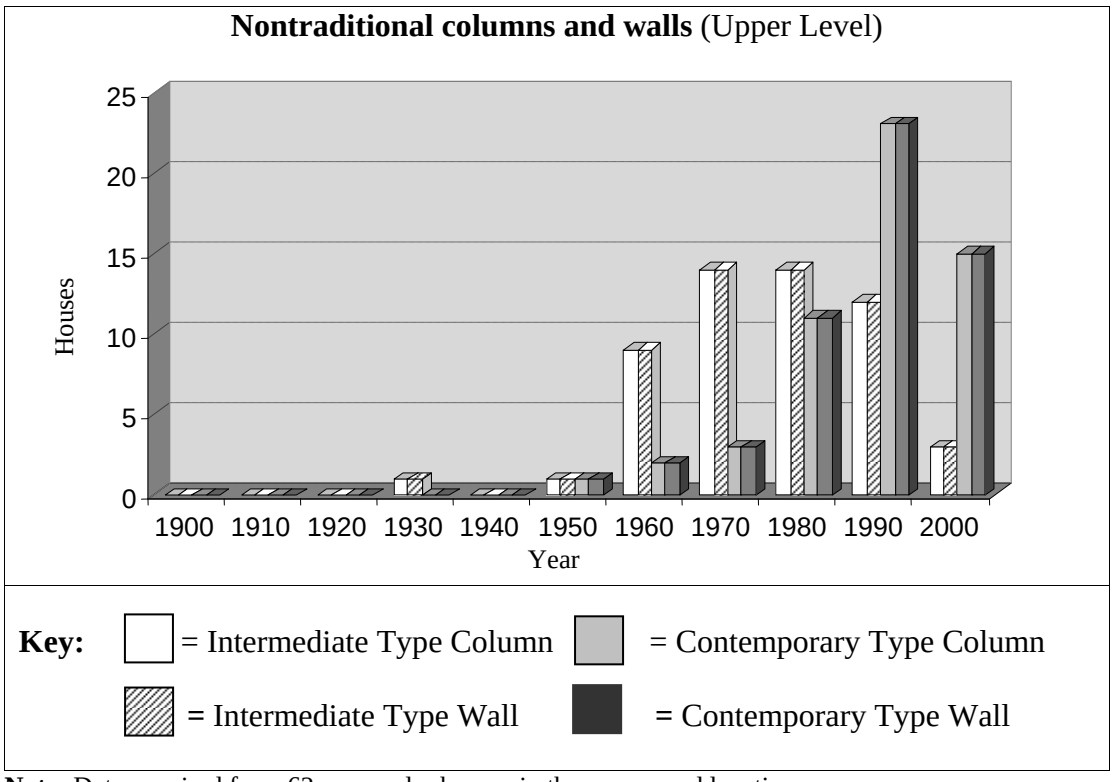
In the intermediate and contemporary groups, the features of columns and walls in the *transforming Thai house* are found in similar proportions. The results of this study show the close relationship between of these two elements.

As the timescale chart in Figure 6.4.2 for both elements shows, the data on the columns and walls are identical. This indicates that the columns and walls have been built using the same process. The last period of traditional construction occurred in the 1980s (see Appendix B).



Note: Data acquired from 54 transforming Thai houses in two surveyed locations: the urban district and rural villages

(a)



Note: Data acquired from 62 vernacular houses in three surveyed locations

(b)

Figure 6.4.2 The beginnings of traditional features (a) and nontraditional features (b) at the upper level columns and walls

The intermediate group shows the transformation of walls from traditional timber to timber weatherboards or corrugated metal sheets with bolted columns starting in the 1930s. They became especially popular in the *transforming Thai houses* from the 1960s to the 1990s. Many residents (31 of the 54 households) stated that the simplicity of the construction process in the intermediate period reduced the cost of any expansion or modification.

The appearance of the contemporary group, which started later than the intermediate group, reflects this change. However, its use is found in a very high number of houses after the 1980s, because of the demand for brick-concrete bathrooms. These are found in both the *transforming Thai houses* and the *reproduction Thai houses*. The residents said that the need for solid brick walls and durable concrete columns started with the bathroom. Although the construction types of the intermediate group were commonly used in the 1960s, bathrooms had already begun to be built with contemporary appearance from the 1950s. The contemporary appearance has been widely used since the 1980s. The other spaces in some *transforming Thai houses*, particularly kitchens, have also been built in this type. In the *reproduction Thai houses*, the contemporary appearance has also been limited to bathrooms at the upper floor level even though the entire construction at the ground floor level is in the contemporary type.

Table 6.4.1 Percentage of features appearing in the three groups (At the upper level columns and walls in three surveyed locations)

Columns and walls (Upper level)				
Groups of features		**Urban district village**	**Rural village**	**Buffer area**
T	**C**	22.8%	24%	85.7%
	W	25.3%	24%	96.5%
I	**C**	70%	70.6%	0%
	W	67.9%	73.1%	0%
C	**C**	7.2%	5.4%	14.3%
	W	6.8%	2.9%	3.5%

Note: C=Column, **W**=Wall

Table 6.4.2 Percentage of uses of each material in three groups (At the upper level columns of features and three surveyed locations)

Upper level column					
Period Group/Materials		**Urban district village**	**Rural village**	**Two villages**	**Buffer area**
T	Timber - Teak - Daeng - Teng -Rung -Makha	 14.2% 3.5% 5.1% 0% 0%	 8.6% 0% 9.4% 2.6% 3.4%	 10.1% 1.5% 7.5% 1.5% 1.9%	 23.5% 0% 62.2% 0% 0%
	Total	22.8%	24%	23%	85.7%
I	a) Timber - Daeng - Teng - Mahogany - Eucaliptus - Pine b) steel	 8.4% 41.5% 12.4% 3.5% 2.7% 1.5%	 6.3% 51.2% 13.1% 0% 0% 0%	 7.2% 47.1% 12.8% 1.5% 1.1% 0.6%	 0% 0% 0% 0% 0% 0%
	Total	70%	70.6%	70.3%	0%
C	a) In-situ cast concrete b) In-situ cast concrete with plaster ornament	7.2% 0%	5.4% 0%	6.2% 0%	11.7% 2.6%
	Total	7.2%	5.4%	6.2%	14.3%

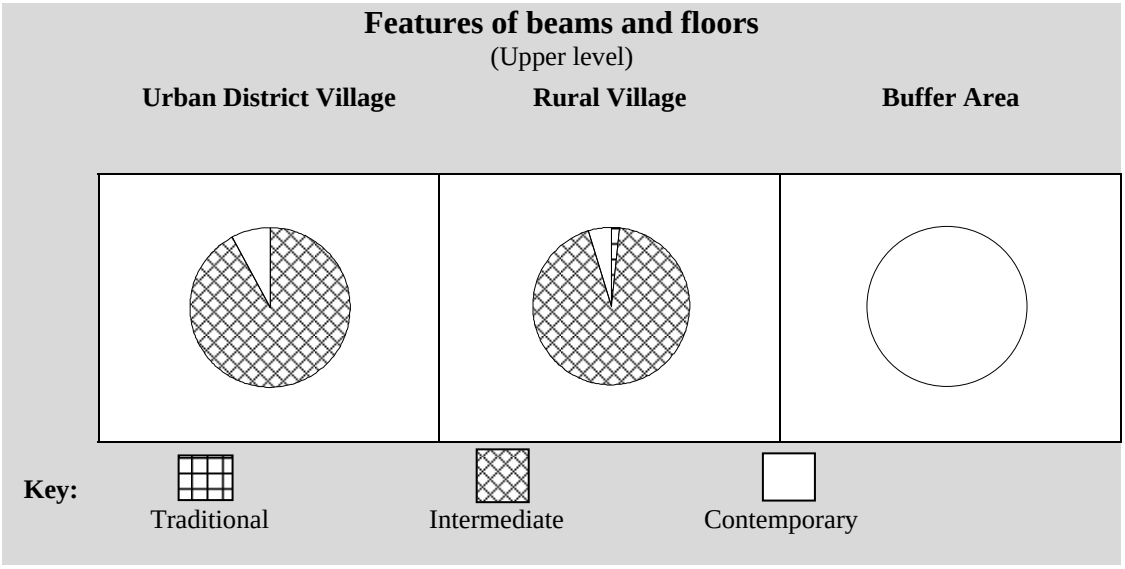
Table 6.4.3 Percentage of uses of each material in three groups (At the upper level walls and three surveyed locations)

Upper level wall					
Period Group/Materials		**Urban district village**	**Rural village**	**Two villages**	**Buffer area**
T	Timber - Teak	 25.3%	 24%	 24.5%	 85.7%
	Total	25.3%	24%	24.5%	85.7%
I	a) Timber weatherboard - Teak - Daeng - Teng - Bamboo b) Corrugated metal sheet	 54.2% 6.2% 4.3% 3.2% 0%	 55.4% 0% 6.4% 4.5% 6.8%	 54.9% 2.6% 5.5% 3.9% 4%	 0% 0% 0% 0% 0%
	Total	67.9%	73.1%	70.9%	0%
C	a) Brick with plaster b) Plastered Concrete block	2.3% 4.5%	2.9% 0%	2.6% 2%	3.5% 0%
	Total	6.8%	2.9%	4.6%	3.5%

6.4.2 Upper level beams and floors

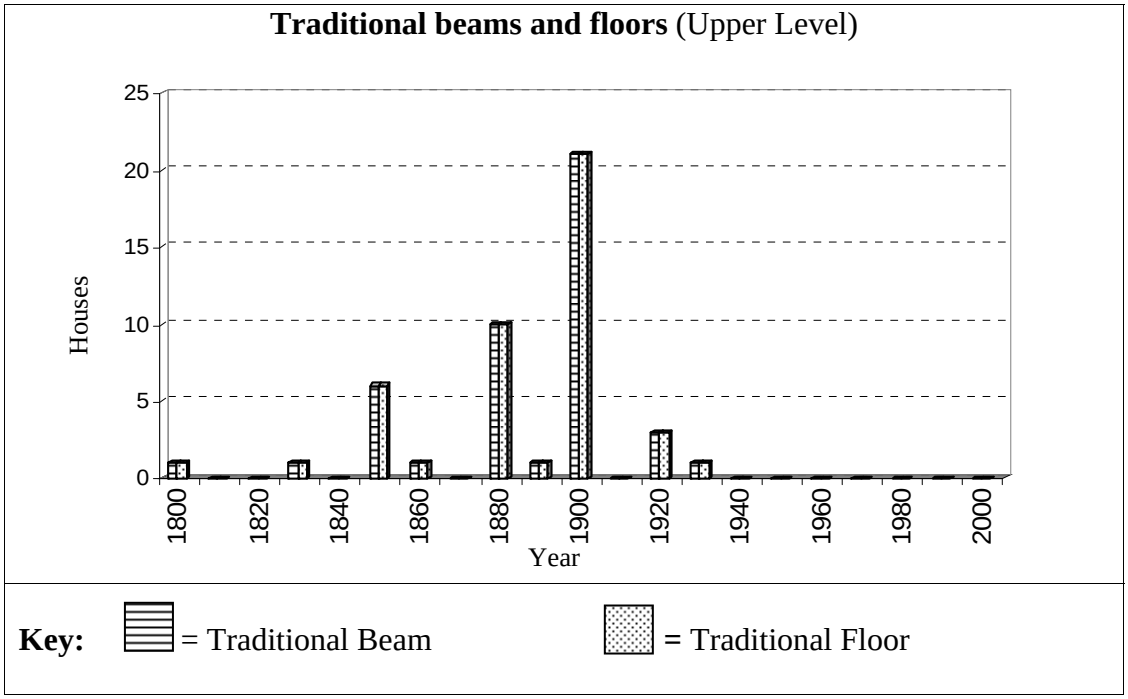
From the pie charts in Figure 6.4.3, the appearance of beams and floors in each group is the same. At present, traditional beams and floors are rarely found in the transforming houses (1.7% in the rural village) due to the introduction, after the 1930s, of joists during the intermediate period. At that time, the floors of the *traditional Thai houses* were often modified to be supported by additional joists. Moreover, the *traditional Thai houses* were sometimes built with a joist-and-beam system from the beginning.

As a result, the beams and floors in both the traditional and nontraditional parts of the transforming houses can be categorized into the intermediate group (92.2% and 93.7% respectively). Only contemporary beams and floors are used in the buffer area. The timber boards are extensively used in the buffer area. Those boards are laid on timber joists supported with concrete beams or laid directly on a solid concrete wall. These can be categorized into the contemporary group.



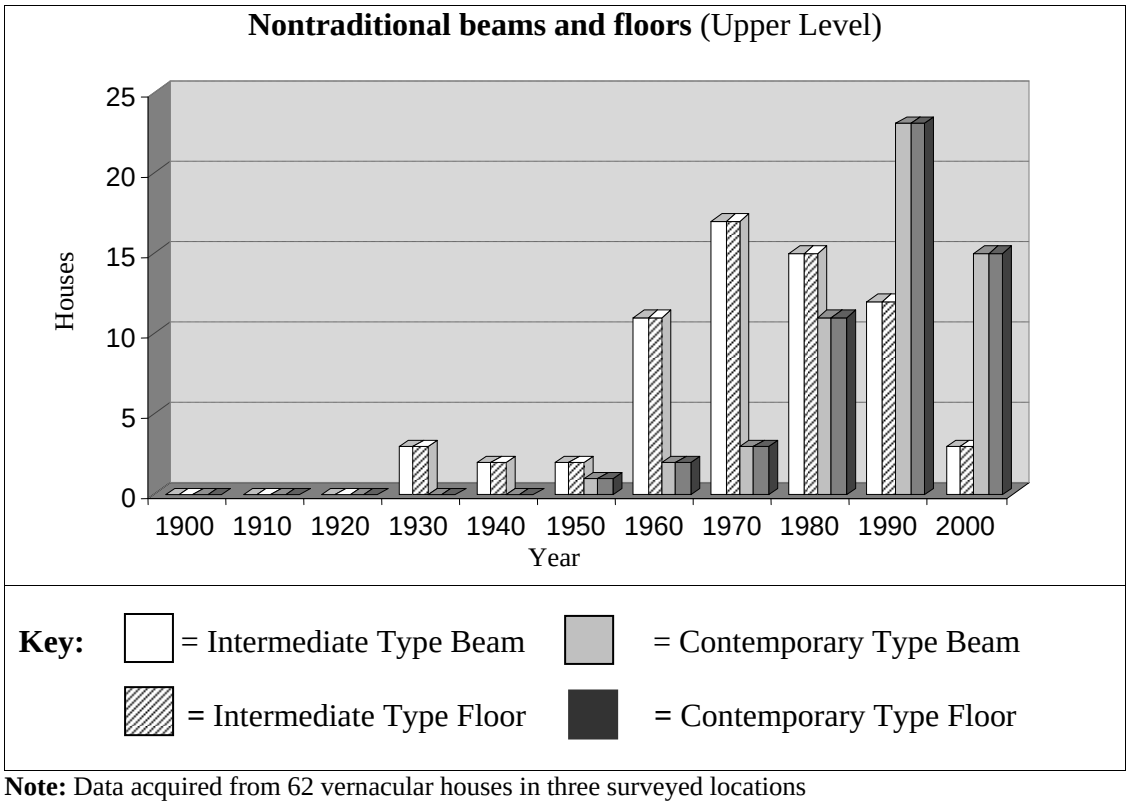
Note: The data are the averaged area or amount of samples.

Figure 6.4.3 Features of the upper floor level beams and floors in three surveyed locations



Note: Data acquired from 54 transforming Thai houses in two locations: the urban district and rural villages

(a)



Note: Data acquired from 62 vernacular houses in three surveyed locations

(b)

Figure 6.4.4 The beginnings of traditional features (a) and nontraditional features (b) at the upper level beams and floors

The appearances of these elements in the urban district village and the rural village are mostly similar with few differences between these two locations. In the intermediate group, Teng is the most commonly used material for the upper level beams both in the urban district village and the rural village. However, teak is used for fewer beams than Teng in the rural village. A popular imported timber, mahogany, is found more in the urban district village than in the rural village. There is no use of other imported hardwoods (Makha and Eucalyptus*)* and softwoods (Pine) in the rural village.

The time-scale chart in Figure 6.4.4 shows that the changes to the beams and floors began before the 1980s, earlier than the changes to the columns and walls. From the surveys, it appears that the traditional features have declined and disappeared since the 1940s. Most of the residents stated that the original beam and floor system required thick timber floorboards, which were rare, expensive, and suitable for a house without heavy furniture.

The changes to the beams and floors in the intermediate group started in the 1930s, which was the same period as the changes to the columns and walls. These features were widely accepted from the 1930s to 1980s. The local builders commented that the use of joists reduced the sag of floorboards and became popular for expanding the *transforming Thai house*, which included any modification of the traditional construction.

In the contemporary group, the construction period of the beams and floors is similar to that of the columns and walls because of the integral process of building them simultaneously. The change started around three decades later than the intermediate group and has been very popular until now. However, contemporary features have been found among only a small number of the samples in the urban district village and the rural village. Similar to the contemporary columns and walls, they occurred in both the *transforming Thai houses* and the *reproduction Thai houses*. In the transforming houses, their use has been typically found in bathrooms and kitchens. In the reproduction houses, all the constructions of beams and floors at the upper floor level are built in the contemporary type.

Table 6.4.4 Percentage of features appearing in three groups (At the upper level beam and floor in three surveyed locations**)**

Beams and floors (Upper level)			
Groups of features	**Urban district village**	**Rural village**	**Buffer area**
T 	0%	1.7%	0%
I 	92.2%	93.7%	0%
C 	7.8%	4.6%	100%

Table 6.4.5 Percentage of uses of each material in three groups (At the upper level beams and floors in three surveyed locations)

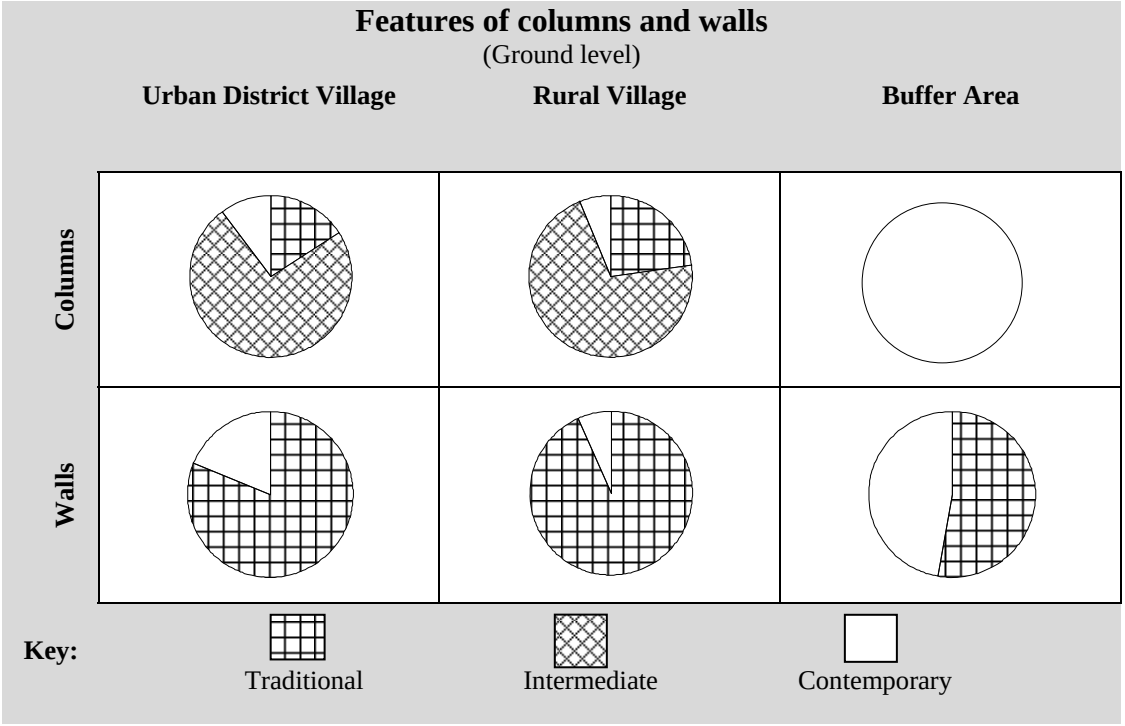
Beams and floors (Upper level)					
Period Group/Materials		**Urban district village**	**Rural village**	**Two villages**	**Buffer area**
T	Timber - Teak	0% / 0%	1.7% / 1.7%	0.8% / 0.8%	0%
	Total	0%	1.7%	0.8%	0%
I	a) Timber - Teak - Daeng - Teng - Rung - Makha - Mahogany - Eucaliptus - Pine	 24.0% / 70.5% 4.6% / 5.5% 43.2 % / 16.2% 3.2% / 0% 4.7% / 0% 8.2% / 0% 2.5% / 0% 1.8% / 0%	 31.4% / 59% 8.7% / 11.6% 31.8 % / 23.1% 9.2% / 0% 0% / 0% 12.6% / 0% 0% / 0% 0% / 0%	 28.2 % / 63.9% 7.0% / 9% 36.6% / 20.2% 6.6% / 0% 2.1% / 0% 10.7% / 0% 1.1% / 0% 0.8% / 0%	 0% 0% 0% 0% 0% 0% 0% 0%
	Total	92.2%	93.7%	93.1%	0%
C	a) Precast concrete b) In-situ cast concrete c) Concrete beam with timber joist and floor	0% / 0% 7.8% / 7.8% 0% / 0%	0% / 1.7% 4.6% / 2.9% 0% / 0%	0% / 1% 6% / 5% 0% / 0%	0% / 0% 87.5% / 87.5% 12.5% / 12.5%
	Total	7.8%	4.6%	6%	100%

6.4.3 Ground level columns and walls

From the pie charts in Figure 6.4.5, the traditional type columns are mostly found in the rural village (22.5%). The intermediate type columns are found in a high percentage in both the urban district village (74%) and the rural village (69.8%). The

contemporary type columns are used for all the houses in the buffer area. Contemporary columns and walls are also found in bathrooms and kitchens in the urban district village and the rural village.

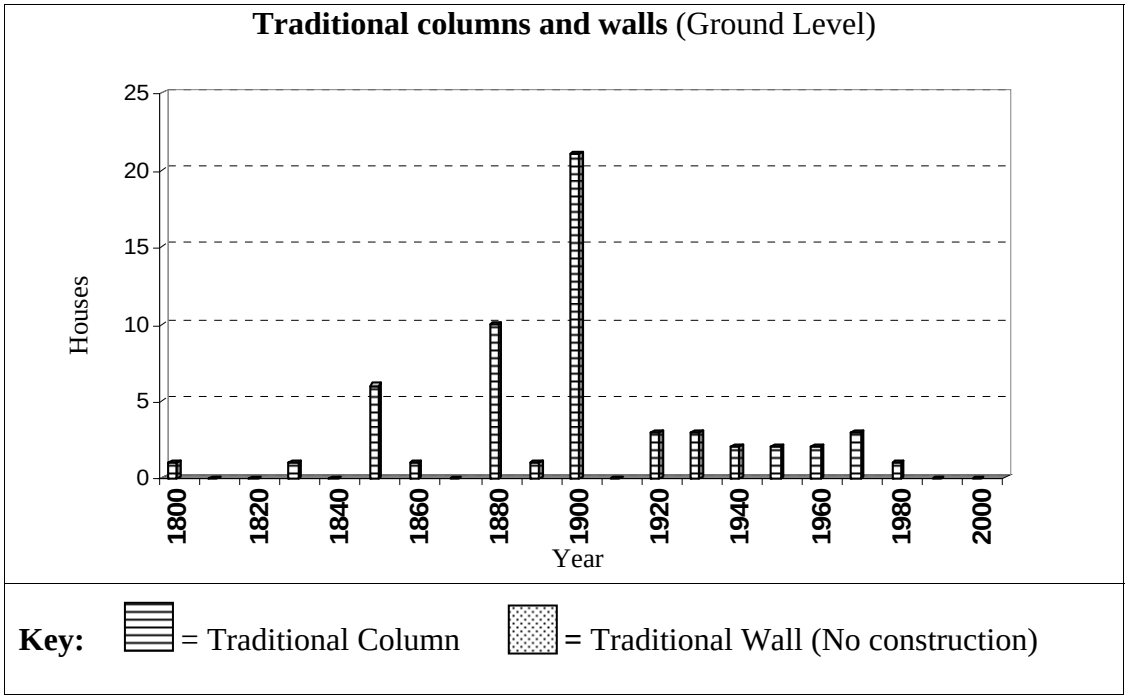
The features of the ground level columns in the urban district village and the rural village are similar. A few differences occur between these two locations. Teng is the most used material for the ground level columns in both villages. Teak is used only in the traditional group and is found less than Teng in the rural village. There is more use of various timbers (such as Makha, Eucalyptus, and Pine) in the urban district village than in the rural village. In-situ cast concrete is the only material used in the contemporary group and is found in the urban district village more than in the rural village.



Note: The data are the averaged area or amount of samples.

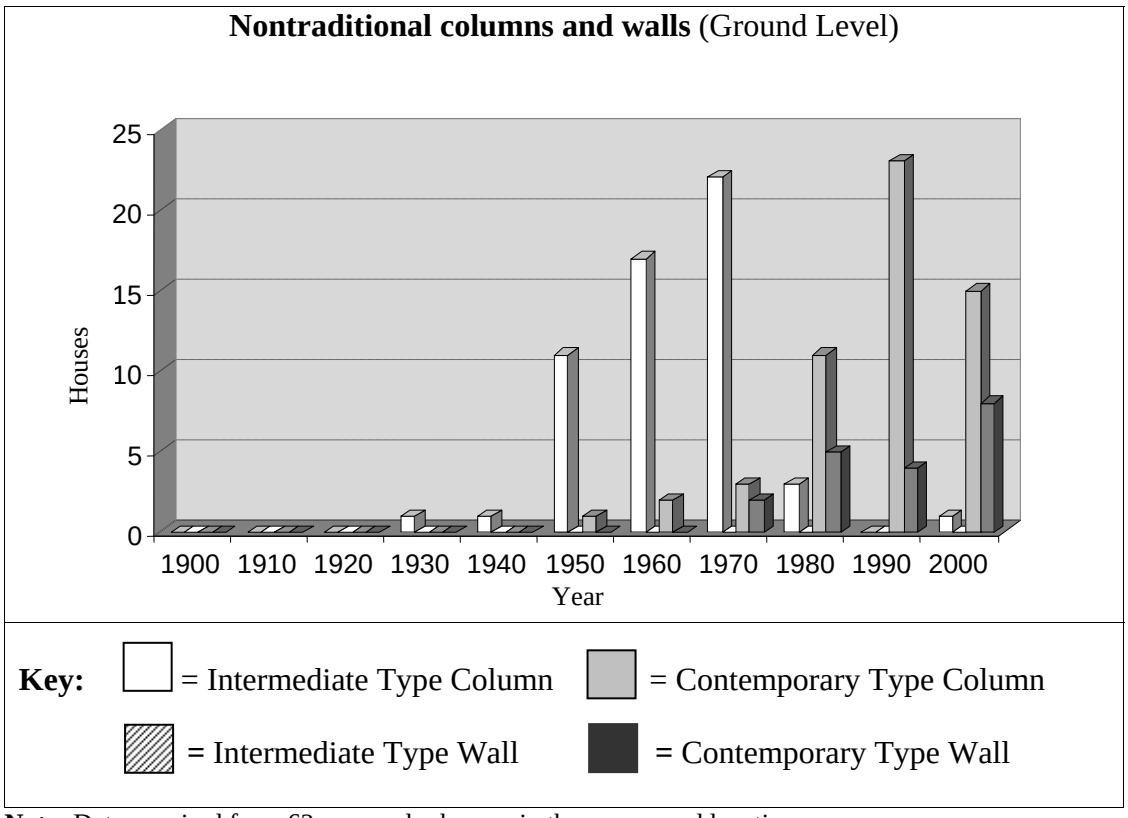
Figure 6.4.5 Features of the ground floor level columns and walls in the three surveyed locations

The data on the traditional type walls do not indicate that many are used at the ground level. In fact, there is no wall at the ground level in the traditional group, but only an open space. Of the *transforming Thai houses* in both villages, a high percentage (81% and 93.2%) has open spaces under a raised house. However, many



Note: Data acquired from 54 transforming Thai houses in two surveyed locations: the urban district and rural villages

(a)



Note: Data acquired from 62 vernacular houses in three surveyed locations

(b)

Figure 6.4.6 The beginnings of traditional features (a) and nontraditional features (b) at the ground level columns and walls

residents (from 37 of the 54 households) stated that they would build more enclosed space in the future if they had the funds. In the buffer area, enclosed spaces are about half of the ground level area and the other half is open spaces. There is no use of intermediate type walls at the ground level in all surveyed locations.

The features at the ground level walls in the urban district village and the rural village show similarities and differences. Most of the areas underneath the houses have no wall, which are categorized in the traditional group, and the use of the industrialized walls is not found. The use of contemporary walls is found in the urban district village more than in the rural village. Concrete blocks are only used in the urban district village.

From the time-scale charts in Figure 6.4.6, one can see that the intermediate type columns are still in use. As discussed previously, there is no use of the early industrial walls at the ground level. The last creation of traditional columns was found in the 1980s (see Appendix B). In the contemporary group, the use of columns and walls are found in both the *transforming Thai houses* and the *reproduction Thai houses.* The uses of contemporary walls at the ground level for creating an enclosed space started around three decades later than the contemporary columns. The masonry walls have now become common at the current and are used for all ground level walls, constructed in the samples.

Table 6.4.6 Percentage of features appearing in three groups of features (At the ground level columns and walls in three locations)

Columns and walls (Ground level)				
Groups of features		**Urban district village**	**Rural village**	**Buffer area**
T	**C**	15.7%	22.5%	0%
	W	81%	93.2%	52.7%
I	**C**	74%	69.8%	0%
	W	0%	0%	0%
C	**C**	10.3%	7.7%	100%
	W	19%	6.8%	47.3%

Note: C=Column, **W**=Wall

Table 6.4.7 Percentage of uses of each material (At the ground level beams and floors in three groups of features in three surveyed locations)

Columns and walls (Ground level)					
Period Group/Materials		**Urban district village**	**Rural village**	**Two villages**	**Buffer area**
T	No Construction	15.7% /81%	22.5%/93.2%	19.1%/87.1%	0%/52.7%
	Total	15.7% /81%	22.5%/93.2%	19.1%/87.1%	0%/52.7%
I	Slab-on-ground concrete	74%/0%	69.8%/0%	71.9%/0%	0%/0%
	Total	74%/0%	69.8%/0%	71.9%/0%	0%/0%
C	In-situ cast concrete	10.3%/19%	7.7%/6.8%	9%/12.9%	100%/47.3%
	Total	10.3%/19%	7.7%/6.8%	9%/12.9%	100%/47.3%

6.4.4 Ground level beams and floors

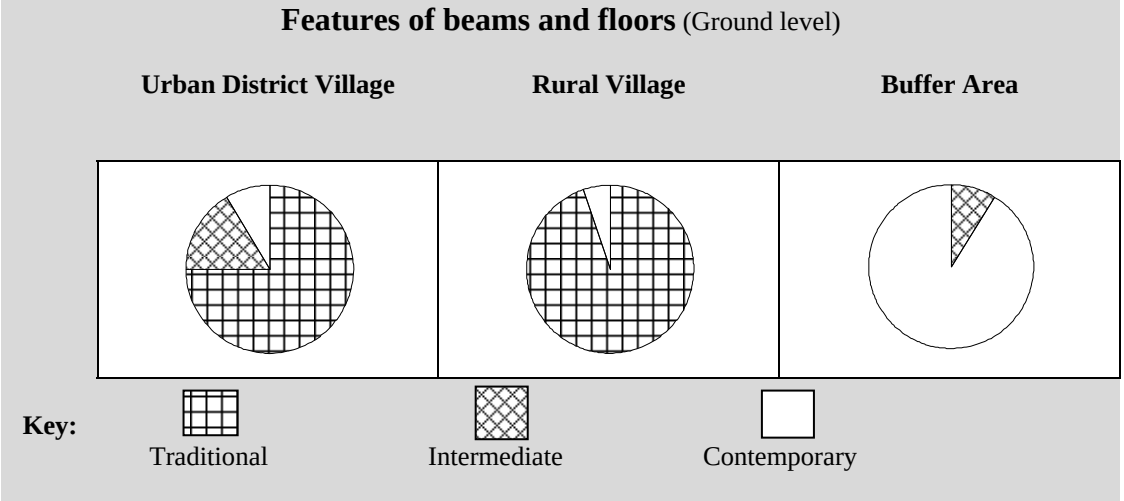
In Figure 6.4.7, the data on the traditional beams and floors show that most of them are traditional features at the ground level. There is no ground level beam in the traditional and the intermediate groups. The area under the raised floor is mainly open space in the urban district village and the rural village. The use of the contemporary beams and floors in these two villages (8.6% and 6.8%) suggests a few enclosed spaces at the ground level. The enclosed spaces are typically built with contemporary beams and floors.

The features of the ground level beams and floors in the urban district village and the rural village are different in the intermediate group. Slab-on-ground concrete is only used in the urban district village. In-situ cast concrete is found in the urban district village more often than in the rural village.

Figure 6.4.8 shows that the use of ground level beams in the contemporary group started in the 1970s. These concrete beams are usually constructed using the same process as for the columns and foundations. The contemporary type beams are found in all *reproduction Thai houses* and some *transforming Thai houses*.

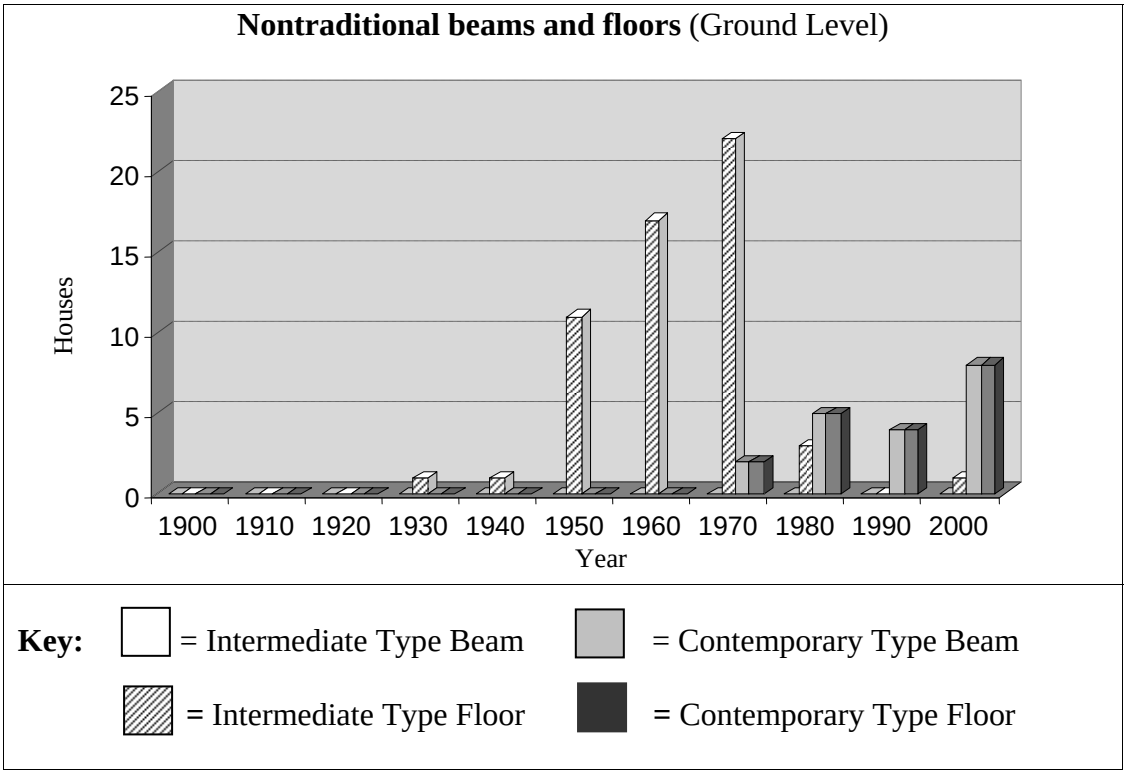
The use of slab-on-ground concrete floors in the intermediate group started in the 1930s and has become common for the *transforming Thai houses*. The number of houses constructed with this type of floor was high in the 1970s. In the contemporary

group, the use of in-situ cast concrete floors started in the 1970s and has been used both in the *transforming Thai houses* and the *reproduction Thai houses*.



Note: The data are the averaged area or amount of samples.

Figure 6.4.7 Features of the ground level beams and floors in three surveyed locations



Note: Data acquired from 62 vernacular houses in three surveyed locations
There are no constructions of traditional features(beams and floors) at the ground level.

Figure 6.4.8 The beginnings of nontraditional features at the ground level beams and floors

Table 6.4.8 Percentage of features appearing in three groups (At the ground level beam and floor in three surveyed locations)

Beams and floors (Ground level)			
Groups of features	**Urban district village**	**Rural village**	**Buffer area**
T 	75% (NC)	93.2% (NC)	0% (NC)
I 	16.4%	0%	9%
C 	8.6%	6.8%	91%

Note: B=Beam, **F=**Floor, **NC**=No construction

Table 6.4.9 Percentage of uses of each material (At the ground level beams and floors in three groups of features and three surveyed locations)

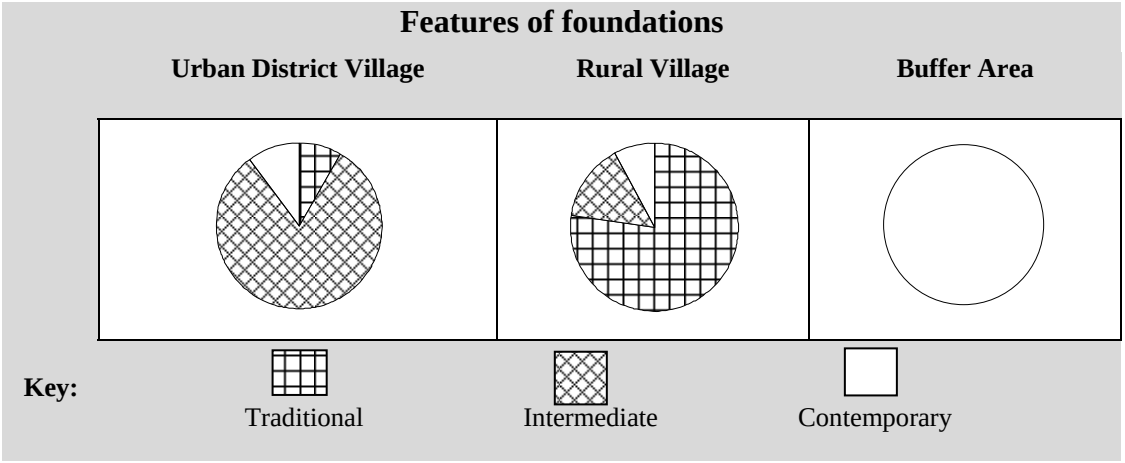
Beams and floors (Ground level)					
Period Group/Materials		**Urban district village**	**Rural village**	**Two villages**	**Buffer area**
T	No Construction	75%	93.2%	85.5%	0%
	Total	75%	93.2%	85.5%	0%
I	Slab-on-ground concrete	16.4%	0%	7%	9%
	Total	16.4%	0%	7%	9%
C	In-situ cast concrete	8.6%	6.8%	7.5%	91%
	Total	8.6%	6.8%	7.5%	91%

6.4.5 Foundations

The traditional type foundation is still found in the rural village (77.1%). From the survey in the rural village, it appears that decayed timber footings have regularly been replaced with the same traditional type. Although the footing replacements in the urban district village comprise both concrete and timber, concrete footings have been mainly found.

Figure 6.4.9 indicates that the early industrial foundations are found in the highest percentage in the urban district village (81.4%). These foundations can be used in both the traditional and non-traditional parts of the *transforming Thai houses*

for expansions or replacements. Contemporary foundations, concrete footings with shallow piles, are found in the bathroom or kitchen constructions of the *transforming Thai houses*. These foundations appear more regularly in houses in the urban district village (10.3%) than in the rural village (7.7%). All foundations in the buffer area use footings with deep piles.



Note: The data are the averaged area or amount of samples.

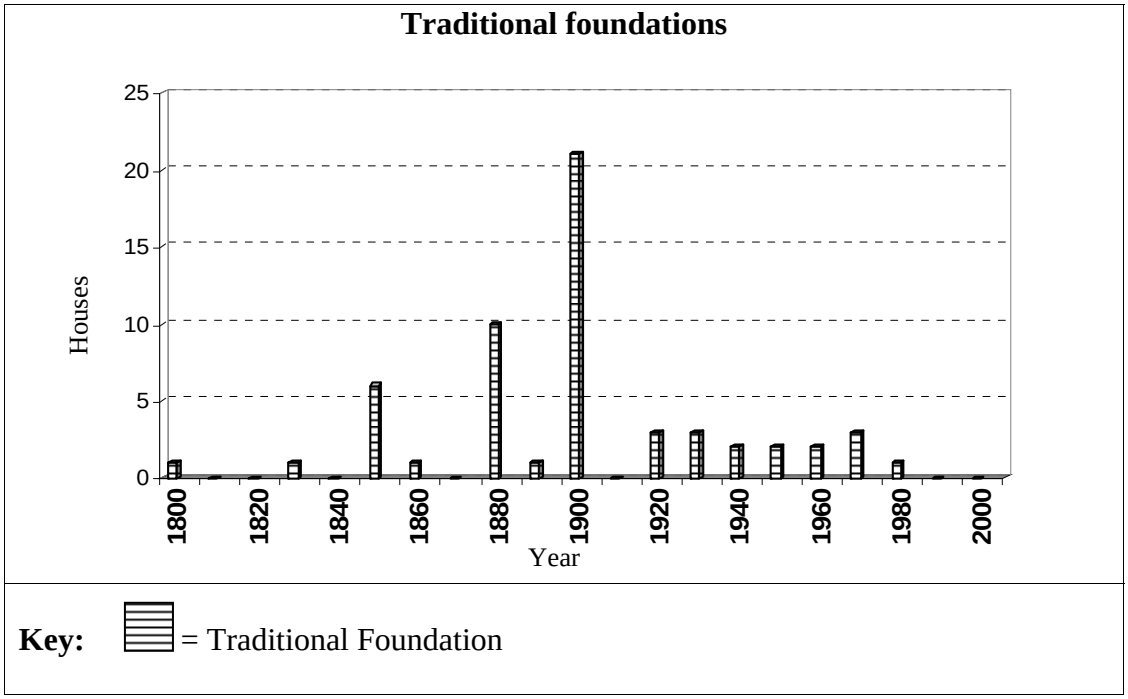
Figure 6.4.9 Features at the foundations in three surveyed locations

There are significant differences between the urban district village and the rural village in the use of each material at the foundations. In the traditional group, most of the timber foundations are found in the rural village and made of Thonglang and Teng. The concrete foundations in the intermediate type are found in the urban district village more than in the rural village.

In Figure 6.4.10, the traditional group relates to the original traditional house and the non-traditional part of the *transforming Thai houses*. The popularity of traditional footing declined after the 1980s. Most of the traditional foundations have been damaged and replaced by timber or concrete footings.

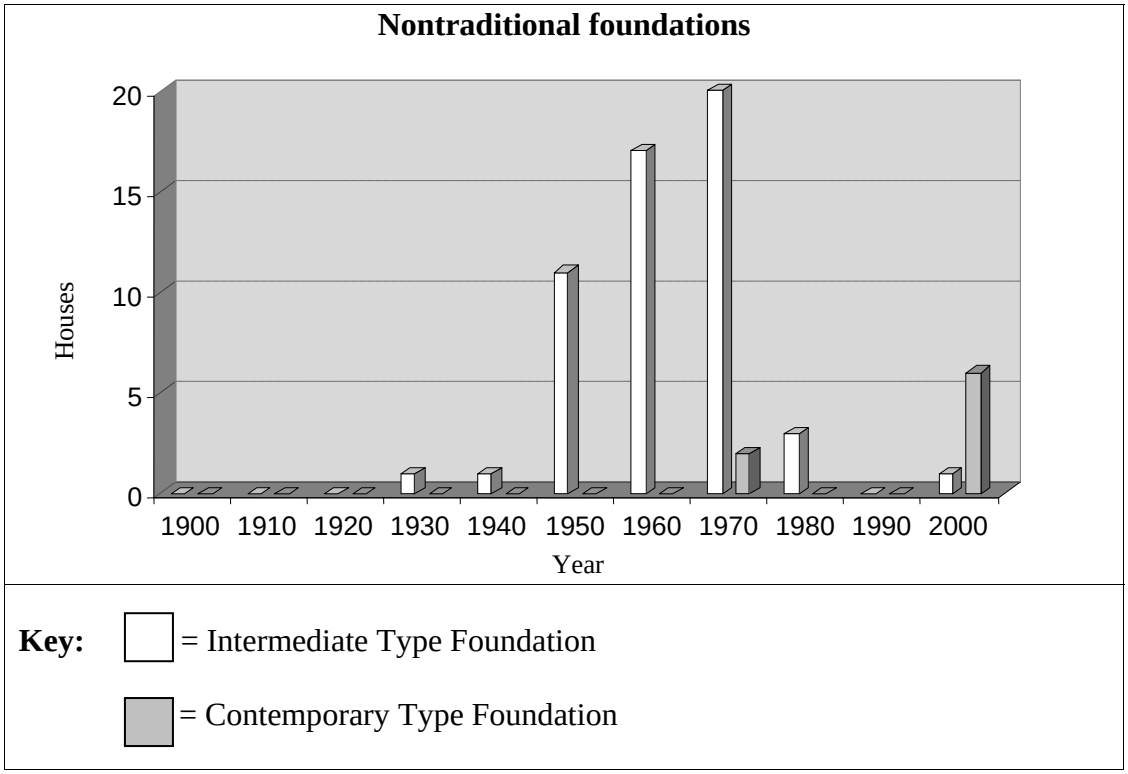
The intermediate group shows a change of use from timber to concrete, beginning in the 1930s and becoming widespread during the 1960s and 1970s. The type of foundation in this group is still found today. Figures 6.4.9 and 6.4.10 show that the development period of the foundation and ground level columns are similar.

The contemporary group shows the use of concrete footing with deep piles which are limited only to the buffer area. These contemporary footings were initially used with brick-concrete houses in the 1970s.



Note: Data acquired from 54 transforming Thai houses in two surveyed locations: the urban district and rural villages

(a)



Note: Data acquired from 62 vernacular houses in three surveyed locations

(b)

Figure 6.4.10 The beginnings of traditional features (a) and nontraditional features (b) at foundations

Table 6.4.10 Percentage of features appearing in three groups (At the foundation in three surveyed locations)

Foundation			
Groups of features	**Urban district village**	**Rural village**	**Buffer area**
T 	8.3%	77.1%	0%
I 	81.4%	15.2%	0%
C 	10.3%	7.7%	100%

Table 6.4.11 Percentage of uses of each material (At the foundations in three groups of features and three surveyed locations)

Foundation					
Period Group/Materials		**Urban district village**	**Rural village**	**Two villages**	**Buffer area**
T	Timber - Thong lang - Teng	 6.3% 2%	 65.7% 11.4%	 40.4% 7.4%	 0% 0%
	Total	8.3%	77.1%	47.8%	0%
I	In-situ cast concrete shallow footing with precast concrete or timber columns	81.4%	15.2%	43.4%	0%
	Total	81.4%	15.2%	43.4%	0%
C	a) In-situ cast concrete shallow footing b) In-situ cast concrete deep footing	10.3% 0%	7.7% 0%	8.8% 0%	0% 100%
	Total	10.3%	7.7%	8.8%	100%

6.5 Comparison of transforming and reproduction houses

In this section, the features of the 11 main construction elements are studied and compared within three main groups: traditional, intermediate, and contemporary. As with the previous sections, these elements are discussed in pairs of structure and cladding. The most typical features for each element and location are highlighted. The residents' reasons for using a particular type will be discussed in Section 6.6.

The results from the previous sections indicate that the uses of the nontraditional type in vernacular Thai houses began with early industrial materials in the 1930s. Intermediate features became common for most of the construction elements in the usual developing locations: the urban district village and the rural village. In these locations, the changes from the intermediate to contemporary type have occurred for two decades, but are found only in a small proportion of the surveyed houses. The contemporary features are found only at the bathroom and ground level constructions in the *transforming Thai houses*.

The popularity of the non-traditional type in fast developing locations shows the changing idea of construction among local builders in the motorway buffer area. The constructions are built with present-day materials instead of early industrial materials. Traditional types are still used at the upper level while contemporary types are found at the ground level. The *reproduction Thai houses* are built not only for the local people living in the surveyed areas but also for clients who live outside the builder's village.

In Table 6.5.1, the traditional features are still found at the roof and the upper level construction elements of the *reproduction Thai houses*. However, the floors and the beams are built with the contemporary type. The traditional features are also found in the foundations and ground floor columns of the *transforming Thai house*s in the rural areas. These two elements are the main elements at the ground level of the *traditional Thai house*.

The intermediate features are typically found at the roof and the upper level construction elements of the *transforming Thai houses* in both the urban and the rural areas. Only in the urban areas are these features found at the foundations and the ground level columns.

Table 6.5.1 A summary of the features: 11 architectural elements in three studied locations

Features									
	Traditional			Intermediate			Contemporary		
	UrbanD	Rural	Buffer	UrbanD	Rural	Buffer	UrbanD	Rural	Buffer
1. R. Cladding	4.9%	1.5%	83.7%	94.8%	91.1%	16.3%	0.3%	7.4%	-
2. R. Structure	26.0%	23.2%	52.1%	73.7%	75.0%	15.2%	0.3%	1.8%	32.7%
3. UL. Column	22.8%	24%	85.7%	70%	70.6%	-	7.2%	5.4%	14.3%
4. UL. Wall	25.3%	24%	96.5%	67.9%	73.1%	-	6.8%	2.9%	3.5%
5. U. Beam	-	1.7%	-	92.2%	93.7%	-	7.8%	4.6%	100%
6. U. Floor	-	1.7%	-	92.2%	93.7%	-	7.8%	4.6%	100%
7. Foundation	8.3%	92.3%	-	70.2%	-	-	21.5%	7.7%	100%
8. G. Column	8.3%	82.5%	-	70.2%	9.8%	-	21.5%	7.7%	100%
9. G. wall	81% (NC)	93.2% (NC)	52.7% (NC)	-	-	-	19%	6.8%	47.3%
10. G. Beam	81% (NC)	93.2% (NC)	-	-	-	-	19%	6.8%	100%
11. G. Floor	79% (NC)	93.2% (NC)	-	2%	-	9%	19%	6.8%	91%

Keys and abbreviations:

-NC = No construction, Highlighted data = Significant features in three locations

-R=Roof, U=Upper level, G=Ground level

-UrbanD=Urban district village or Pakkran village, Rural=Rural village or Ladchado village, Buffer=Motorway buffer area or Bangpahun area

The contemporary features are commonly found at the ground level and some construction elements at the upper level of the *reproduction Thai houses*. At the ground level of the *transforming Thai houses*, these types are usually found at the enclosed spaces.

The results suggest that the residents and the local builders in the ordinary developing locations prefer the intermediate features for most of the constructions. The traditional appearances have been maintained and are found at the small parts that were the *traditional Thai houses*. By contrast, the traditional types are widely applied in the fast developing locations. The upper level of the houses is made in the traditional type, while the ground level part is made in the contemporary type. This combination is used to build new forms, including the lay-out plan of the *reproduction Thai house*.

6.6 Residents' opinions about the changing features

In addition to the discussions about the physical surveyed data, information on the opinions of residents about the changing features was derived from the third phase of the interview. Because of the limited survey time, the residents firstly gave their overall opinions about the features in the three main parts of the building: the roof, upper level construction and ground level construction. After that, only some construction elements which had been significantly changed were discussed in detail. The residents sometimes provided more than one reason for each feature. Their reasons could be categorized into four groups: 1. Functionality; 2. Economy; 3. Aesthetics; and 4. Modernized appearance.

In Table 6.6.1, the most typical features found in each element (drawn from previous sections) are presented together with the residents' explanations. The results from the urban district village show that the nontraditional features have been mainly applied because of their functionality, durability, and safety. Most of the nontraditional features found in the urban district village are in the intermediate group with early industrial materials. The contemporary features are used for bathrooms and enclosed spaces at ground level. The results show that some residents (9 out of 23 households) changed from the traditional type to the intermediate type for economic reasons. A few residents (3 out of 23 households) considered that the intermediate type was applied because of their modern appearance when the constructions were newly built in the past. Aesthetics did not play a part in the residents' decision.

Table 6.6.1 Reasons for changing from traditional to nontraditional features

Residents' reasons for change															
	Urban District Village					Rural Village					Buffer Area				
	Character	23 households				Character	31 households				Character	8 households			
		FD	E	A	M		FD	E	A	M		FD	E	A	M
1. Roof Cladding	IT	● 23			● 3	IT	● 31			● 5	T			● 7	
2. Roof Structure	IT	● 23	● 9		● 3	IT	● 31	● 16		● 5	T			● 8	
3. UL. Column	IT	● 23	● 9		● 3	IT	● 31	● 16		● 5	T			● 8	
4. UL. Wall	IT	● 23	● 9		● 3	IT	● 31	● 16		● 5	T			● 8	
5. UL. Beam	IT	● 23	● 9		● 3	IT	● 31	● 16		● 5	C	● 8	● 1		● 8
6. UL. Floor	IT	● 23	● 9		● 3	IT	● 31	● 16		● 5	C	● 8	● 1		● 8
7. Foundation	IT	● 23				T		● 31			C	● 8			
8. G. Column	IT	● 23	● 9		● 3	IT		● 31			C	● 8	● 1		● 8
9. G. wall	C	● 10			● 2	C	● 1				C	● 8	● 1		● 8
10. G. Beam	C	● 10			● 2	C	● 1				C	● 8	● 1		● 8
11. G. Floor	C	● 10			● 2	C	● 1				C	● 8	● 1		● 8

Keys and abbreviations: -Reasons of use: FD= Functionality or Durability or Safety, E=Economic, A=Aesthetic, M=Modernized appearance

Highlighted cells show the most typical reasons. Residents can choose more than one reason. Feature columns show the most dominant feature for each element.

-U=Upper level, G=Ground level, T=Traditional group, IT=Intermediate group, C=Contemporary group

The results in the rural village are similar to those in the urban district village. Durability, safety and functionality are the main reasons for the application of an intermediate type. A few residents (4 out of 31 households) mentioned modern

appearance (when the construction was new) as a factor, while none mentioned the aesthetics. However, the continuous use of the traditional type at the foundations in the rural area shows a significant difference from the urban area.

Additionally, most of the intermediate type columns at the ground level are still timber columns. The residents explained that they were been familiar with repairing or replacing the house elements with timbers. They also stated that these timbers had been readily available and inexpensive compared with timbers found in urban areas.

Some residents (6 out of 31 households) revealed that they were more concerned about the construction at the roof and the upper level than at the ground level due to the long periods spent living at the upper level of the house and the muddy conditions of the ground level after the seasonal flood.

The results from the motorway buffer area show two main groups of reasons. First, the application of the traditional type is for aesthetic reasons. Second, the various reasons for the application of the contemporary type are functionality and durability, as well as a modernized appearance. Most residents or builders agreed that the high cost of building a house in a contemporary type was accepted. The local builders stated that the residents or their clients could afford all-timber houses but they preferred to live in the half-timber houses with some features of a modern house. Nevertheless, a few residents argued that the contemporary constructions were cheaper than constructions with good quality timber. So, the contemporary types were also used for economic reasons.

All residents in the buffer area wanted their houses to combine both traditional and modern elements. They agreed that only timbers built with traditional techniques were appropriate for use at the upper level. They also believed that the roof and the upper level construction were more important than the ground level construction. Therefore, the construction at the ground level, including the beams and floors of the upper level, were flexibly built in a recent type. The construction at the ground level was also intended to have a modern appearance and meet the functional requirements of everyday life.

In summary, the rural and urban district areas, which have been generally developed, show that functionality, durability and safety are widely valued by the residents. These reasons have supported the change from traditional to intermediate features. Some differences occur because of the dissimilarity of the urban district and

rural locations. The information from the motorway buffer area, which is more developed than the urban district and rural areas, shows that aesthetics is the important reason for continuation of the traditional type. Meanwhile, modernized appearance and durability are the reasons for adopting the contemporary features.

6.7 Conclusions

The findings in this chapter confirm that Thai vernacular houses have shifted from the popular image of the *traditional Thai house*, which is restricted only to a certain period. The comparison of *traditional Thai houses* and other types of Thai vernacular houses shows some important issues that have never been addressed. The analysis demonstrates the dynamic nature of vernacular houses which have been activated by various causes, including materials.

From Chapters 4 and 5, the appearances of the vernacular houses are complicated and sometimes hidden because of transformations, which have occurred in various periods. To understand the appearance of vernacular houses, the dominant features in the main transformations are presented, including a comparison between samples in the urban district and rural villages. The results suggest that the intermediate features in the enclosed hall control most of the type throughout the whole construction. This confirms the importance of the hall as the place where residents spend most of their time at home.

The intermediate features, which have been used in the transforming houses, were selected from elements of bungalow-influenced houses. However, the local builders and the residents could change many elements of a bungalow to combine harmoniously with their traditional houses. Although the residents stated their pride in the remaining elements of the *traditional Thai house* that were still part of their house, the traditional type is not dominant in the main transformations. The contemporary type, on the other hand, strongly dominates the features of bathrooms at the upper level of the house. This type causes an awkward appearance when it is put together with other types. The durability and functionality of brick and concrete construction is the main reason for the selection of the local residents.

At the roof, the intermediate features significantly dominate the *transforming Thai houses* in both urban district and rural villages. The contemporary features are rarely found in the study areas. This proves that there have been a few changes in the

roofing after the popularity of the intermediate type. The features of the roof structures in both villages mostly belong to the intermediate group. The residents and local builders are very conservative when choosing the features for a pitch roof, but more flexible for a new roof form.

At the upper level, there are greater numbers of traditional-type columns in the *reproduction Thai house*s than in the *transforming Thai house*s. In both urban district and rural villages, the residents restrict the use of the traditional-type columns to the traditional parts only. The intermediate-type features are also mostly found comparing with others. In both villages, the appearance ratio of the traditional-type walls is lesser, when comparing to the *reproduction Thai houses* in the motorway buffer areas, which are used for almost the whole part of the upper level of the houses. In the buffer area, builders maintain the overall appearance of the upper level of the houses in a traditional type.

The traditional-type beams and floors are rarely found in the studied areas. These beam and floor systems required thick timber floorboards, which were rare, expensive and suitable for a house without heavy furniture. The beams and floors in the intermediate group originated from the same period. These features have been widely accepted among the local builders.

At the ground level, the intermediate-type columns are typically found in the urban district village and the rural village. The contemporary-type columns are used in the buffer area. The use of contemporary-type columns and walls are found in bathrooms and kitchens in both villages. In the *transforming Thai houses* in both villages, open spaces without a wall of the space underneath the house are still found. In the buffer area, enclosed spaces with the contemporary-type walls comprise about half of the ground level area, with the other half left as open spaces. The masonry walls have now become common and are used for all ground level walls.

There are no beams and floors at the ground level in the traditional group. The contemporary-type beams are found in all *reproduction Thai houses* and some *transforming Thai houses*. The traditional foundations are still found in the rural village and have regularly been replaced. Intermediate-type footings, made from concrete, have been found in the urban district village as replacements.

Because this study focuses on the active way in which vernacular and modern traditions merge, a comparison of transforming and reproduction houses helps to widen the concept of vernacular architecture. The building tradition of new vernacular

forms confirms that the idea of a fixed and static past has faded away in vernacular villages.

Intermediate features became common for most of the construction elements in the ordinary developing locations (the urban district village and the rural village). One of the factors involved when matching the nontraditional type with vernacular Thai houses is the materials and construction techniques from the early industrial period. The non-traditional type in the fast developing location (the motorway buffer area) shows the changing idea of construction among local builders. The constructions are built with contemporary materials instead of the early industrial materials.

In the ordinary developing locations, the traditional appearances have been maintained and found at the important sections of the house. The small traditional segment, surrounded with different types of constructions, was a unit of the cluster of the *traditional Thai houses*. By contrast, the traditional features are widely applied in the fast developing location. The upper level of the houses is made in a traditional type while the ground level part is made in a contemporary type. The combination of types, including new forms and lay-out plans, come from the innovation of the local builders. Therefore, the *transforming Thai house* is a major development for the vernacular Thai house in the 20th century. Likewise, the *reproduction Thai house* is the innovation emerging during the late 20th century and the beginning of the 21st century.

The results of the interviews with the residents showed that the traditional type was changed to the intermediate type because of functionality, durability, and safety. Economic and aesthetic issues were minor reasons for the change. The traditional type has been continued at the recent footings in the rural village because of the availability of timber in the local area. In the buffer area, the house builders have taken an effort to merge contemporary features with the traditional constructions. At the present, the reproduction houses have been admired because they combine graceful traditional type with modernized appearance, while providing durability. All of the residents in the three locations agree that the traditional appearance represents their heritage and is more graceful than the contemporary appearance.

Chapter 7
Conclusions

7.1 Introduction

This study focuses on vernacular buildings, which are the *transforming Thai house* and the *reproduction Thai house* that have evolved from the traditional Thai house for ordinary people and integrated with new technologies of construction. It is also concerned with the adaptability and the transmission of knowledge in an era of technological advancement and cultural change. The need for recalibration of attitudes towards vernacular buildings has been a key element of analysis throughout the work. This approach has tried to break from conservative ideas towards an understanding of living traditions.

Some vital clues from the findings will encourage a greater understanding of non-monumental building with its cultural significance in order to continue the vernacular tradition. This study revealed that for many decades there has been the development of new types of Thai vernacular houses. However, these houses are still unrecorded, unrecognized and uncelebrated. These contemporary vernacular houses will serve as a starting-point for future research and education. The investigation of materials and construction methods concerning with transformation and reproduction of the vernacular houses provide strong support to the survival and continuation of local knowledge, prevailing in vernacular villages.

All those research findings are summarized in Section 7.2. Approaches in the upcoming charter are discussed in Section 7.3. Suggestions for legislation are purposed in Section 7.4. Further research and considerations for supporting Thai vernacular houses are presented in Sections 7.5 and 7.6.

7.2 Summary of the research findings

In this section, the research focuses on two main issues of the findings: new definitions of the Thai contemporary vernacular architecture and circumstance of changing uses of materials. These are discussed as follows:

7.2.1 New definitions of the Thai contemporary vernacular architecture

This study has emphasized dynamic and change of vernacular building traditions. Because of many backward conceptions, vernacular building traditions have been often viewed with ideas of a romantic past, picturesque poverty and underdevelopment. However, vernacular buildings have responded and reacted to technological and cultural changes as well. Their adaptability is evidenced by many appropriate responses and solutions reflected in the contemporary vernacular houses.

The findings of this study indicate that the recent development of the Thai vernacular houses follows two main paths: transformation of the *traditional Thai house*; and emergence of new house types with an image of the *traditional Thai house*. In the studied locations, many *traditional Thai houses* have been used continuously since the late 19th century. However, these houses have been modified and extended to respond to changes in ways of life and demands of the residents toward modern and contemporary living. Thus these traditional houses have modified and extended by integrating modern forms and using modern technologies of construction. Modification of the houses was usually occurred around the halls and the porches, while extension was found around cooking spaces and additional bathrooms with wooden or concrete structure. In some cases particularly in urban district villages, an extended construction was also found at ground floor level by enclosing the space underneath the house with walls to form interior space.

In addition, extensions particularly with bungalow roof were one of the early construction changes applied to the traditional house. Modifications of construction elements have continued to take place among traditional houses or extended construction. Traditional houses that have undergone such changes are defined as the *transforming Thai house*. Even though this type of the *transforming Thai house* has been mostly developed in urban district villages and rural villages, they are different in their overall features due to the availability of materials and labors. While the bungalow style has been continuously constructed to joined-up structure with the traditional parts in many vernacular houses and in many locations, the *reproduction Thai house*s, which have recently appeared, have emerged in the zone along the motorways close to the vernacular village. These houses were not only built for reproducing the popular image of the traditional Thai house but also were redesigned to merge with the contemporary construction as found in typical urban housing

developments in Thailand. As a result, these houses conformed to modern demands, using a variety of materials and techniques.

In this study, the new Thai vernacular houses can be divided into two main types: the *transforming Thai house* and the *reproduction Thai house*. However, these two types of houses revealed different qualities of their own. The *transforming Thai houses* express an evolution of the traditional Thai houses, while the *reproduction Thai houses* demonstrate a revival of the traditional Thai style in newly constructed houses. Also, the *transforming Thai houses* suggest a concept of continuation and conservation, while the *transforming Thai houses* imply an adaptation of tradition to compromise with new contexts. However, these two types of houses have been merging new technologies and transmitting the vernacular heritage to a new generation of Thai people.

7.2.2 Circumstances of change

The findings of this research indicated the process of change in the construction elements. These imply the development direction of Thai vernacular houses. The findings also suggested that the developments have been influenced by non-traditional features and construction types. The continuation of the change has been in association with materials and construction methods, especially since the early period of Thai industry.

The analysis of the uses of materials and methods demonstrates that there were typical patterns of change occurring in each construction element. There was no transfer or adaptation of the traditional ways to the nontraditional parts of the house. In urban district villages and rural areas, the intermediate feature, in which the traditional construction types were joined-up with the construction update types, was commonly found. However, foundations of the *transforming Thai houses* particularly in the rural areas were the only construction elements, retaining the use of traditional ways. For this study, this transforming way of modification is usually influenced by “intermediate type”, which has been applied for many decades.

In the motorway buffer areas, the *reproduction Thai houses*, which are defined in this study as “contemporary vernacular house”, visibly expressed as two parts: at ground floor level and the upper level. The house at the ground level typically

appeared in contemporary feature, while the house at the upper level was still in traditional feature.

The residents began to replace the traditional house with the intermediate type of modification in the 1930s. Most construction elements with intermediate type were obviously found in the 1960s, but declined after the 1990s. It seems that modifying the traditional houses with intermediate type became a popular model only in a certain period. However, the modification with intermediate type is still used in recent constructions of vernacular Thai houses, especially in urban district villages and rural villages. The construction of traditional house with contemporary type appeared after the houses with intermediate type for two decades. This style of construction has become popular since the 1970s.

The residents' opinions suggested that there were some reasons to encourage the residents to change their choices of selecting building materials and methods of construction. This study also found that the reasons of modification for the residents were different in according to their living locations. On the one hand, the most popular reasons for selecting building materials in general locations were their durability, functionality and safety. On the other hand, the residents' choices of selection in fast-developing locations such as the villages along the motorways were not only with those concerns as in general locations. They were also concerned with modern appearance and traditional aesthetic of materials and construction methods.

This study found that the contemporary type of construction as found along the motorways has less applied to the *transforming Thai houses*. This intermediate type of construction has still been a popular choice for the villagers who live in urban district villages and rural villages. Although many modern materials and construction methods were used to build the *reproduction Thai house* in the motorway buffer areas, the traditional techniques were still those of highly skilled builders.

In overall process of transformation was usually composed of both modification and extension through the house. Each extension or modification usually expresses its different characteristic, reflecting the careful selection by the residents. Consequently, the appearances of the vernacular houses are complicated because of transformations in many periods. The finding suggested that in most vernacular houses the intermediate type of construction controlled most features in the whole building appearance.

In an era of technological advancement and increasing communication, vernacular Thai builders have transmitted building traditions in various ways. From the findings in this study, scholars should no longer assume that vernacular builders are unskilled, technologically ignorant or isolated from global communication. The emergence of new types of a vernacular building confirms the continuity of local knowledge in building construction.

7.3 Approaches for promoting conservation of vernacular houses in Thailand

Vernacular houses are one of the elements expressing cultural significance and identity of the locality, particularly in rural landscape of Thailand. This study found that even though some vernacular houses have been modified and developed to respond with the residents' ways of life and their decisions regarding materials and construction methods provided in their locality, some of them are still in risks of disappearing. Outstanding examples of vernacular houses in many locations have been disappearing usually because of the problems of the residents' economic situation and lacking of awareness of their house values. Finding an approach to maintain and to continue them is still needed.

The Fine Arts Department (FAD) is the most significant organization, being the principle organization in charge of conservation, and the department which is essentially responsible for the registration of sites (Poshyanandana 2005). Nowadays, there are some concerns in heritage management and conservation. In general, heritage management models are classified into three approaches: the Conventional Approach, the Values-based Approach, and the Living Heritage Approach (Baillie 2007). These three approaches represent different frameworks resulting from politics, social contexts, and world trends in heritage management and conservation. These models are being used at the moment and some are more suitable to some kinds of heritage than others (ICCROM 2009).

7.3.1 Conventional approach

The Conventional Approach is related to the protection of the past. This approach has its root in the idea that heritage is a vulnerable resource. As a result, the approach focuses on the historical heritage and resists change without consideration of the opinions from the local community. In Thailand, this approach is associated with

early conservation frameworks such as the Act on Town and Country Planning 1975, and the Building Control Act 1979.

It appears that the focus of the Acts is on an area which has a monument or core area. The control occurs only at the place of the authentic monument such as royal palaces and temples. The setting of vernacular houses owned by ordinary people often is not included.

7.3.2 Values-based approach

The Values-based Approach was developed for the needs of different groups of people. There was an expansion of values associated with heritage as acknowledged by the indigenous people, including social and religious values.

It is recognized that some parts in Thai regulations have integrated international concepts on conservation and Thai traditional ways based on institutions, religions, beliefs, and Thai ways of life.

The Fine Arts Department Regulations on Conservation 1985 states in Article 16 shows some conservation aspects relating to vernacular buildings:

> "Living monuments are not required to keep their original features in case of additional functions or change of functions. It is acceptable for necessary additions or alterations. However, the new parts should harmonize with the original and should not have damaging effects to the original values."

The Office of Environmental and Natural Resource Plan and Policy (ONEP) provided the Enhancement and Conservation of National Environmental Quality Act of 1992. This Act covers some broad environmental issues, but as a cultural heritage issues, Part 3, Section 42 to 45 is relevant:

> "Conservation zones which can work with local authorities to launch local regulations to limit development in certain areas. They can also control the surroundings of a heritage site by implementing various degrees of control depending on what is required, from very strict control to control which allows managed changes."

This approach is still expert-led and seen as the Conventional Approach with some issues of participation and multiculturalism. Value-based vernacular buildings are usually outstanding-style buildings (colonial-style buildings, renowned-owner houses, royal family houses, church, mosque, and shophouses in historical markets). Heritage experts from FAD still act as the main protectors who control the heritage

discourse. Therefore, this approach and Thai regulations need to be revised for more appropriate ways.

7.3.3 Living heritage approach

Since the mid 1990s, the Thai heritage-related organization supported decentralization of FAD power, giving more power to the local community. The Living Heritage Approach aims to decolonize conservation (Sully 2007). It moves away from the old concepts which are material-based approaches to be community-based. The first priority will base on the needs of the traditional community. The most important aspect of this approach is that it allows change to take place to the heritage, while recognizing change as an agent of continuity. This is because heritage is viewed as a continuous process and the tangible and intangible aspects are inseparable (Carman 2002). Heritage professionals will facilitate the conservation in heritage which will lead to community-based actions reducing dependency from the state or government in terms of manpower and other resources. This approach can help to expand opportunity for heritage managements to the traditional communities.

In November 2005, ICOMOS Thailand held a seminar called *2 Decades of ICOMOS Thailand: Cultural Heritage Conservation*. It was an important progress of a charter which is exclusively for Thai contexts. The presidents of ICOMOS Thailand, stated that:

> "This charter will be a true reflection of ideas, ways of life, and culture of the Thai people; a guideline that is truly suitable for our country and people".

Vajvisut (2005) gathered the outcome and stated that many issues about vernacular buildings should be included in the upcoming Thailand Charter.

From three approaches discussed here, the Living Heritage Approach seems to be the most suitable for a vernacular community. The continuous interaction between vernacular buildings and their users is encouraged because the aim of this Living Heritage Approach is to conserve continuity. It also aims to promote an inclusive understanding of heritage, which incorporates local knowledge, practices, perspectives, and traditional skills. This approach will be able to initiate appropriate local legislation and to empower heritage professionals to work with the public. A balance between the needs of the indigenous community and conservation has to be considered in the legislation.

In studied locations, a basic problem is that Thai legislation does not provide or support any incentives to the villagers in order to have their properties registered with conservation plan. Thus, these villagers of those vernacular buildings are not willing to cooperate with the authorities or government servicers to survey their building for the registration process. For them, they understand that there is no direct gain, while it will be immediately put restrictions upon them if their building is under conservation plan. The registered building is a difficult one to make flexibly changes to their own heritage properties.

To encourage more villagers to take part in conservation plan, upcoming Thailand Charters should support and encouraging instead of penalizing. The charter and other related regulations should include schemes such as offering tax incentives, rewards, tourism, and education to promote the new approach for the living vernacular heritage.

7.4 Further suggestions

There are seven topics arrived from the study to suggest legislation regarding heritage management in the context of studied locations in Central Thailand. These suggestions are important issues which could occur through conservation action plans and the drafting process of the upcoming Thailand Charter.

7.4.1 Interpretation of vernacular buildings

Heritage interpretation needs to be inclusive. In most heritage sites, there are different layers of history gathered by the vernacular communities. These layers define their relationship with the heritage. In order to facilitate a sustainable heritage management, these different layers will need to be included in the interpretation.

In the studied locations of this research, vernacular buildings are important to their traditional communities, but they are not part of the national history and are often neglected. Therefore, it should neither exclude history of vernacular communities in many local places, nor select only the most prominent and beautiful parts of history to express in the public worldwide. An inclusiveness of interpretation will allow the heritage to be appreciated and conserved. The findings indicate the supportive data for better interpretation of vernacular houses such as the new definition of contemporary vernacular architecture, the process of transformation, new

types of vernacular houses, and the new value of vernacular house with early industrial and contemporary materials.

7.4.2 Updated legal framework

The laws and structure of heritage governance laws should allow an inclusiveness of the vernacular community. The villagers should be encouraged to take part in heritage conservation. Cultural Heritage laws have to give rights to villagers to participate in the protection of heritage. A reward program listed in the law is a good example on how the villagers can be encouraged to safeguard their vernacular buildings. As a result, it is needed to be an update of the outdated legal framework to better reflect the present situation of vernacular buildings and villages. In the studied locations of this research, local regulations should be emphasized because of context-based approach. Therefore, an enabling framework should act as follows:

-Be inclusive of various types of heritage;

-Acknowledge an ownership of heritage by vernacular community; and

-Encourage participation of the local population and organizations in protect their heritage, or support role of management in their heritage.

7.4.3 Roles of government organizations

With the Living Heritage Approach, the roles of the heritage and government organizations are to support, assist, advice, and facilitate the vernacular community within their own expertise and capacity. The conservation should base on the traditional knowledge and system initiated from the local context. The expertise of the heritage authorities can support the community with their technical knowledge in order to improve the capability in heritage management of the local residents.

In some countries such as United States of America, United Kingdom, and Japan, the private sector has been encouraged to involve in the preservation of individual structures; a number of tax incentives have been improved and provided by the government to help with the costs of preserving private historic buildings. With this incentive, the private sectors became more interested in having their historic structures and districts designated and this resulted in the growth in employment in building preservation, restoration and rehabilitation.

In Thailand, the government does not offer tax incentive to support heritage preservation and conservation. However, there are examples of exceptional cases such as the project of commercial buildings on Na Phra Lan Road and Old Phuket historic district preservation. First, the historic preservation project of shophouses on Na Phra Lan Road in Bangkok that is a collaboration between the Crown Property Bureau and the leaseholders who are required to pay only one-fourth of the costs, Second, the Old Phuket historic district preservation project in southern Thailand that is implemented and managed by Old Phuket Foundation who utilizes money from many sources including municipality to support old building owners who wish to restore their building in this historic district (Pimonsathean 1997). However, both are self-initiated historic preservation projects and there is no policy framework from the Thai government.

7.4.4 Heritage education

Heritage education is an important part to generate awareness in vernacular heritage among the general public. Heritage education should be more introduced in programs or activities for the public to understand heritage. This can be done at the local level. Local heritage should be introduced to students. This will help to enhance pride and senses of ownership to the local residents. In addition, heritage education for the public level is necessary and it can be achieved through a series of activities, such as heritage tours and exhibitions.

In the studied locations, heritage education's field trips and classroom programs will also support participation which will lead to proper development and conservation of vernacular houses. It was found that the communities have potential in conducting participatory planning. The villagers, who have more heritage information or education, usually participate and gave more time to the researchers in the conservation scheme.

7.4.5 Training in craftsmanship and knowledge transfer

The loss of skills in vernacular craftsmanship is a critical issue because the knowledge to reproduce the heritage has been disappearing. The vernacular heritage can be continued by establishing training activities in traditional skills that are related to the use and care of vernacular buildings. In the past, senior monks transmitted the

skill of carpenter and masonry builder to other young monks, who gave labor for building temple, monk residences, and houses in their village.

In the studied locations of this research, the craftsmen of vernacular buildings are still found in the motorway buffer areas. The head of the Thai house builders, who are respected as a teacher, work with young colleagues and hand down his local knowledge to the next generation without documentation. Heritage managers could arrange the training courses for promotion of Thai wood and masonry techniques. Local Thai wisdom should be better observed and recorded.

7.4.6 Research on vernacular buildings

Although many vernacular communities have maintained its traditional use and care of their heritage through time, research on vernacular knowledge is rare. The heritage authorities can help vernacular communities by conducting research projects to gain a better understanding of the local knowledge. An example of a research topic is the properties of materials, techniques, and skills in construction. The research results should be well documented and distributed so that the knowledge can be accessed and understood.

7.4.7 Traditional materials

In Thailand, there have been some concerns on the scarcity of traditional materials, especially wood, to facilitate conservation of those vernacular houses in the future. Alternative materials should be considered such as steel for replacement of timber structure although pricey wood is still available and imported from neighboring countries. Therefore, it is a duty of all involved in heritage management and conservation to integrate the factors, such as traditional materials, relating to the sustainability of vernacular buildings into the process.

7.5 Recommendation for further study

This study shows that more research projects in the field of vernacular buildings and traditions are still needs to be continued. Some recommendations for future research are as follows:

1. It is still needed to search for the ways to interpret and acknowledge the hidden heritage, such as the *transforming Thai house* defined in this research. This is

to provide information to the public tourists, and the households, who possess those vernacular houses.

2. It is also still required the ways to create public participation. This is to encourage and to support the householders to sustain their vernacular houses. It also includes their participation to search for approaches to sustain all intangible factors of their local culture and traditions.

3. In order to sustain vernacular values and knowledge, it is needed to allow local craftsmanship to be evolved. Thus, the study on craftsmanship should include not only the traditional techniques of construction, but also those alternative techniques invented by the local builders. The goal is to maintain the characteristics of the vernacular tradition and pass it on to the next generations and the public realms.

4. The organizations, working related to the conservation, should concern and include vernacular dwellings of the ordinary people into the visions, policy and strategy of Thailand's conservation. Thus, this will support some recommendations for the efficiency and effectiveness of the cultural heritage management policy for non-monumental architectures.

7.6 Consideration for supporting Thai vernacular heritage

At present, some settings with vernacular architectures may be identified as a conservation zone, which is normally controlled by the conservation acts or guidelines. From the results in this study, it is not necessary to prepare an act or guidelines for conserving the vernacular heritage because of its dynamic nature. A formal and rigid conservation plan may incorrectly control evolution or development of vernacular traditions. In many occurrences, conservation plan and methods has resulted in fixing many cultural heritages at a certain nostalgic period, which is popular to tourists or scholars. However, this control interrupts not only the process of evolution, but establishes new difficulties to householders of vernacular houses as well.

Provision of incentives or positive information should be considered to encourage the traditional builders and the villagers to sustain their heritage in their own way. Therefore, this contemporary concept is needed to be addressed to scholars, architects and planners who take a responsibility for a master plan of conservation and development. Because the Thai government rarely has a budget for vernacular

heritage that is not monumental architecture or a tourist destination, raising awareness of the owners of vernacular houses needs the information support from institutional efforts. The issues of vernacular heritage should be promoted to general public beyond the territories of a small group of professionals and practitioners. This information needs to be properly managed by scholars, builders, and key persons of the villagers.

All local villagers should understand the value of their vernacular architecture so that they will agree to protect, to conserve, or to change it. Moreover, the villagers need local authorities to support their plans and to protect their villages from any undesirable impacts. The most important factor in the existence of vernacular architecture is the power of the community to raise understanding and awareness regarding the value of its tradition and culture. As a result, the villagers can appreciate, build up their stewardship, and keep their heritage for successors.

To support vernacular heritage, tourism development is considered to be one of the most suitable and relevant starting points. The most important aspect of this approach is that the villagers should have the capability of recognizing this phenomenon in an appropriate manner. This can be achieved if local villagers are able to set up their rules and regulations for tourism without destroying the culture and architecture of their community. For this reason, the villagers should also be able to select the tourists, whom they want to attract without changing the nature of transformation and reproduction of their vernacular houses. This will utilize local resources to gain benefits from various kinds of local knowledge and their evolution. Cultural reproductions, such as products relating to a *traditional Thai house*, can be promoted both in the villages and areas along the motorways.

The other ideas regarding resolutions of non-monumental heritage include providing education and setting up a self-help organization. Providing education to the villagers involves promoting the dissemination of villagers' local wisdom to their children. Institutions may help by funding children or key persons in the villages for relevant courses. A village organization should be set up to be a center for people to congregate, to exchange and to transfer knowledge, and to generally help each other. This organization can guide the villagers in terms of their adaptation to tourism and new development. It can also function as an interpretation center, providing a rich, accurate, and entertaining understanding of various forms of vernacular architecture and its context for visitors. An establishment of local education and organization will

help to continue and to sustain their vernacular knowledge and culture, and thus maintaining identity and diversity of local environments of the country.

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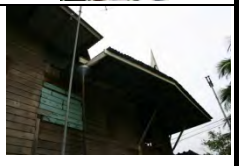
Appendix A

Appearances of House Samples

No.	Location	Area (sq.m)	Picture 1	Picture 2	Picture 3
01 Dpk01	Urban district	206			
02 Dpk03	Urban district	405			
03 Dpk04	Urban district	180			
04 Dpk05	Urban district	272			
05 Epk01	Urban district	340			
06 Epk04	Urban district	263.6			
07 Upk05	Urban district	284			
08 Tpk03	Urban district	196			
09 Tpk05	Urban district	467			
10 Tpk06	Urban district	370			

No.	Location	Area (sq.m)	Picture 1	Picture 2	Picture 3
11 Chpk01	Urban district	180			
12 Chpk03	Urban district	333.5			
13 Chpk04	Urban district	198			
14 Chpk05	Urban district	358			
15 Ppk01	Urban district	359			
16 Ppk02	Urban district	474.5			
17 Ppk04	Urban district	222			
18 Ppk05	Urban district	362			
19 Ppk06	Urban district	276.2			
20 Ppk07	Urban district	457.4			

No.	Location	Area (sq.m)	Picture 1	Picture 2	Picture 3
21 Ppk08	Urban district	364			
22 Dld06	Rural	674			
23 Dld07	Rural	460			
24 Dld08	Rural	374			
25 Dld09	Rural	240			
26 Eld03	Rural	370			
27 Eld05	Rural	410			
28 Eld06	Rural	354			
29 Eld07	Rural	268			
30 Eld08	Rural	588			

No.	Location	Area (sq.m)	Picture 1	Picture 2	Picture 3
31 Eld09	Rural	490			
32 Eld10	Rural	538.2			
33 Uld03	Rural	282			
34 Uld06	Rural	325			
35 Uld08	Rural	322			
36 Uld09	Rural	389			
37 Uld10	Rural	545			
38 Uld11	Rural	255.4			
39 Tld04	Rural	440			
40 Tld08	Rural	284			

No.	Location	Area (sq.m)	Picture 1	Picture 2	Picture 3
41 Tld09	Rural	402			
42 Tld10	Rural	473			
43 Chld02	Rural	802			
44 Chld06	Rural	317			
45 Chld07	Rural	416			
46 Chld08	Rural	420			
47 Chld09	Rural	386			
48 Chld10	Rural	378			
49 Chld11	Rural	189			
50 Pld09	Rural	324			

No.	Location	Area (sq.m)	Picture 1	Picture 2	Picture 3
51 Pld11	Rural	470			
52 Dbh10	Buffer	660			
53 Dbh11	Buffer	982			
54 Ebh11	Buffer	493			
55 Pbh10	Buffer	717			
56 Tbh11	Buffer	548			
57 Chbh12	Buffer	571			
58 Epk02	Urban district	168			
59 Upk02	Urban district	641			
60 Upk04	Urban district	126			

No.	Location	Area (sq.m)	Picture 1	Picture 2	Picture 3
61 Ppk03	Urban district	552			
62 Dld02	Rural	1,238			
63 Uld01	Rural	184			
64 Tld01	Rural	203			
65 Pld12	Rural	854			
66 Tbh02	Buffer	154.7			
67 Tbh12	Buffer	1,340			

Appendix B

Address, Plan, and Elevation of Samples

Appendix C

Example of the photographs used for supporting the survey form

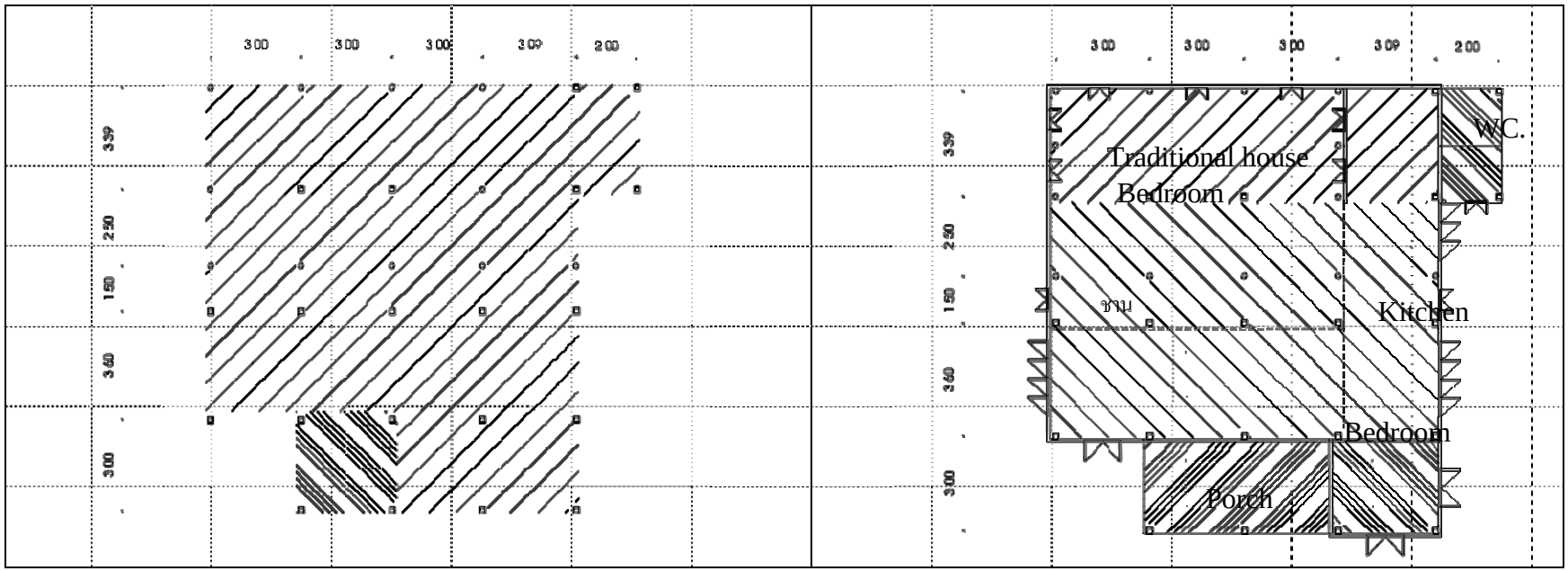
Appendix D

Example of the survey form

Example of Survey Form (House No. 04 in the urban district village)

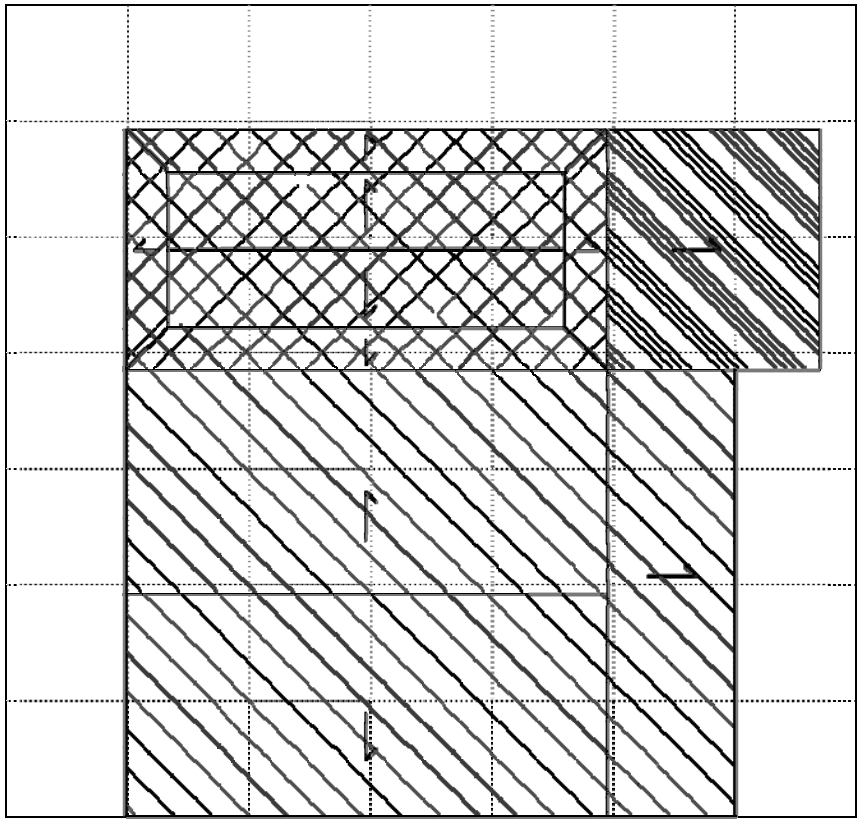
Plan

1.1	1.2	1.3	3.1	3.2		
Changed part: 1900	1962	1977	1979	2002		



…4.. M.

Ground Floor **Upper Floor**

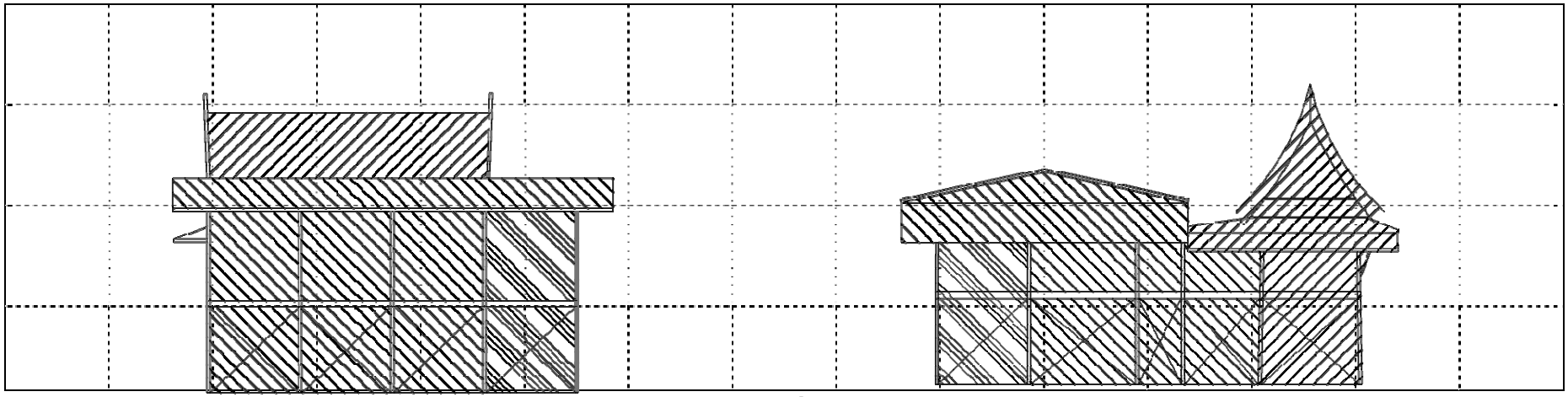


Roof Floor

Period of construction:

1900 1.1
1962 1.2
1977 1.3
1979 3.1
2002 3.2

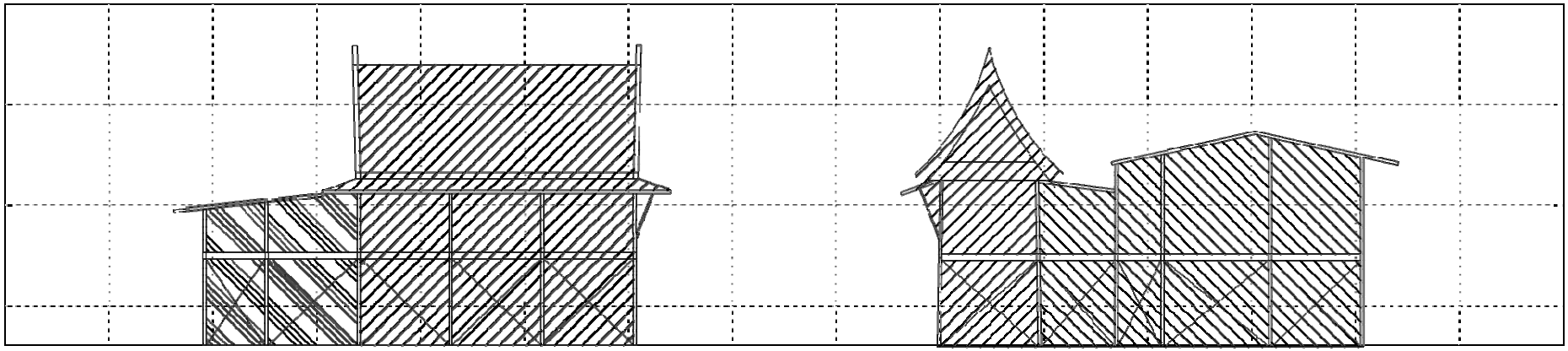
Elevation



Front

Right

…3. M.



…3. M.

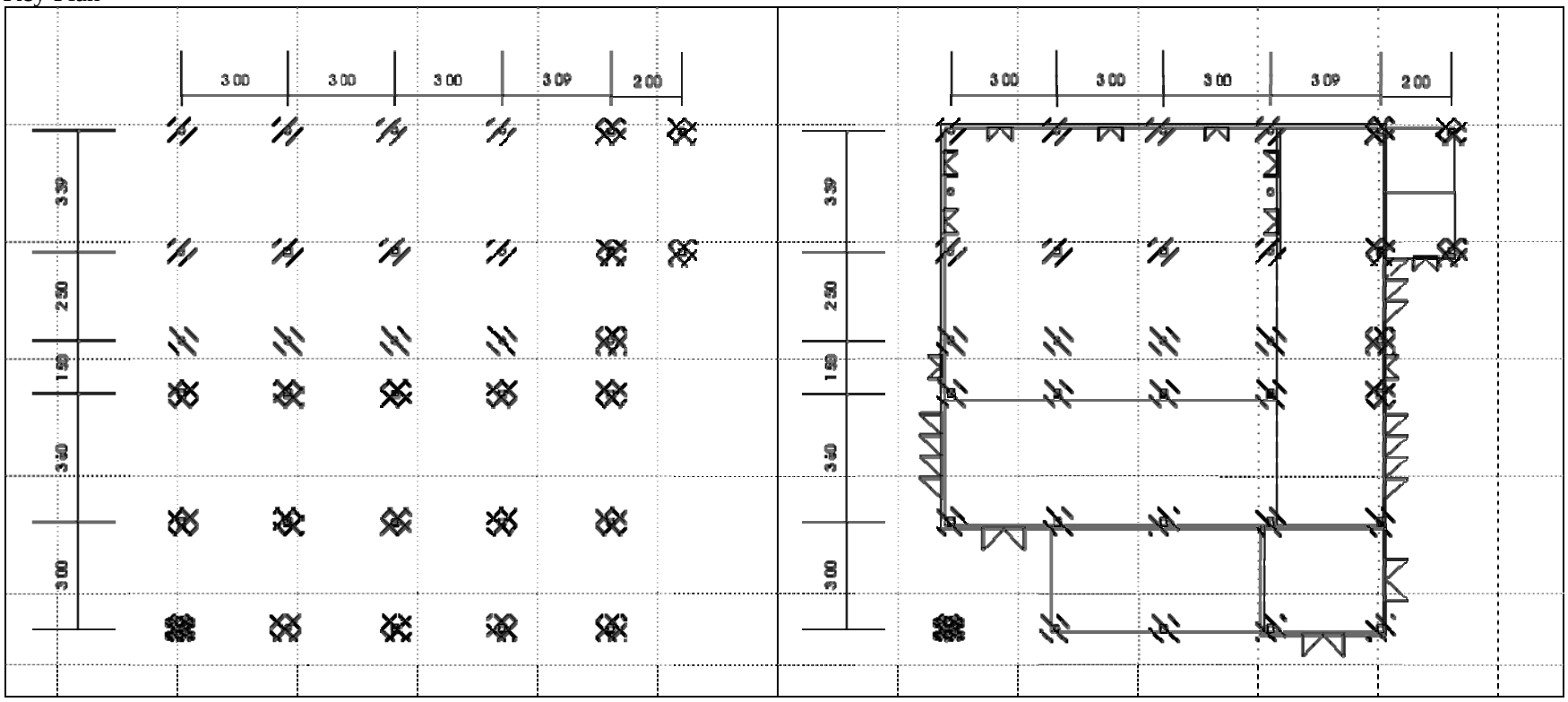
Back

Left

Main Structure

Mat: Old hard wood | New hard wood | Precast Concrete | Steel

Key Plan

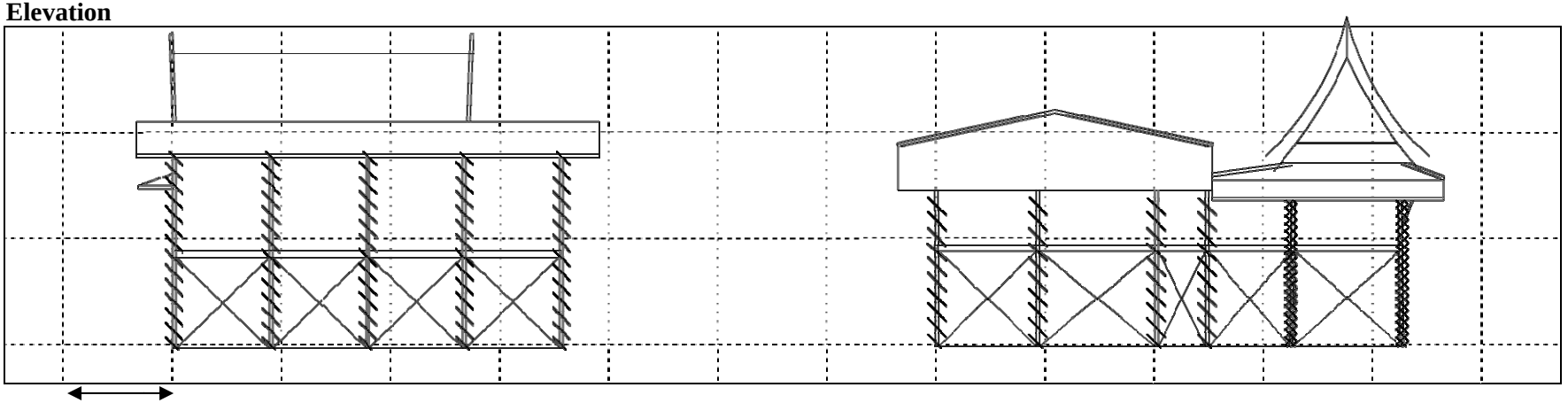


…3.. M.

Ground Floor

First Floor

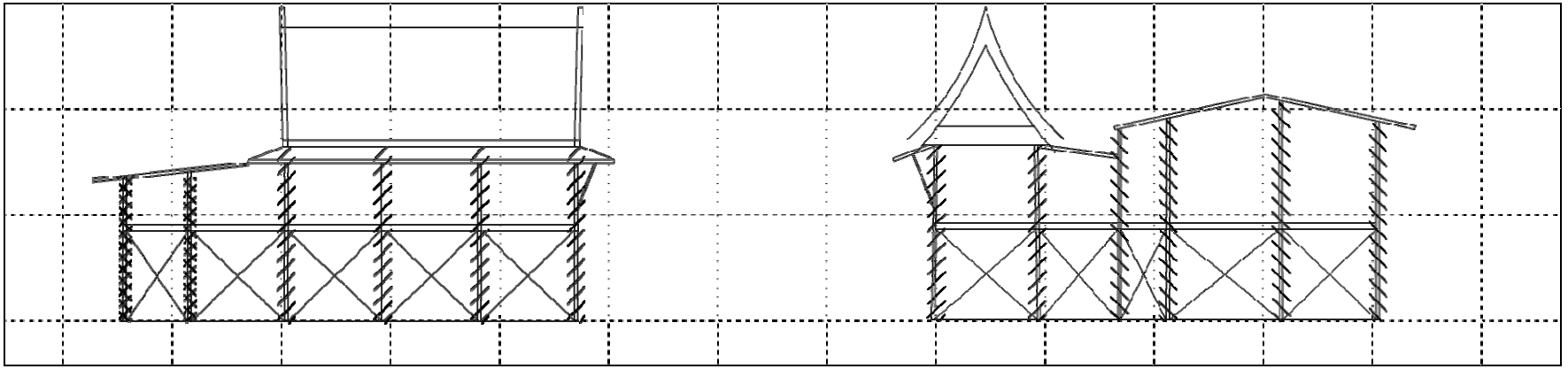
Elevation



Front

Right

Elevation

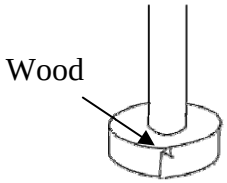
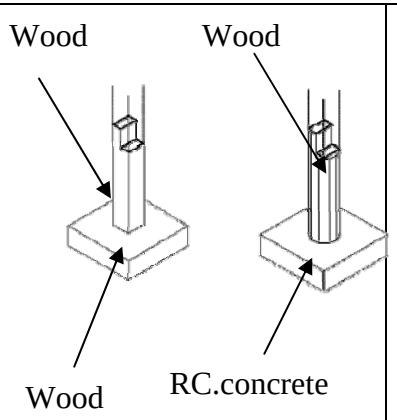
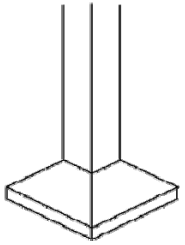
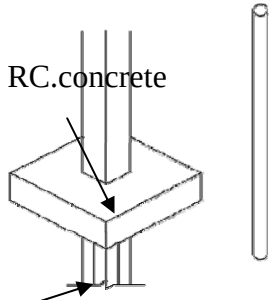


…3 M.

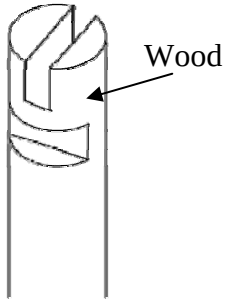
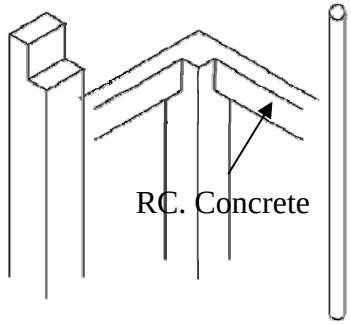
Back

Left

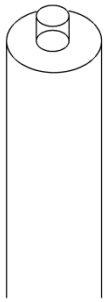
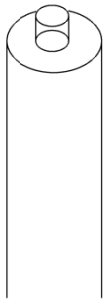
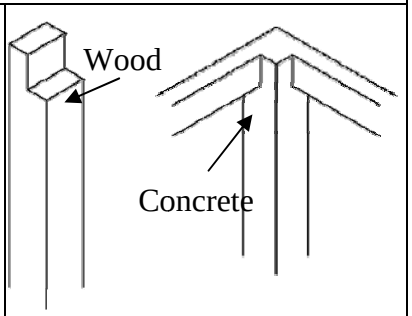
Foundation

Data				
	Original (At the beginning)	**1. Original with minor change (At the present)**	**2. Original with major change (At the present)**	**3. Expansion**
		Part No.	**Part No.**	**Part No.**
Materials	**Hard wood**	Hard wood	-	RC. Precast / RC. cast in place / Steel
Age/Year	1990	1979	-	1979 / 2002 / 2002
Condition			-	
Amount	8	4	-	15 / 4 / 1
Sketch of Construction Detail				
				

Ground Floor Column

Data				
	Original (At the beginning)	**1. Original with minor change or no change (At the present)**	**2. Original with major change (At the present)**	**3. Expansion**
		Part No.	**Part No.**	**Part No.**
Materials	Hard wood	Hard wood		Precast RC. Cast in place RC Steel.
Age/Year	1990	1979		1979 2002 2002
Condition				  
Amount	8	4		
Sketch of Construction Detail				
				

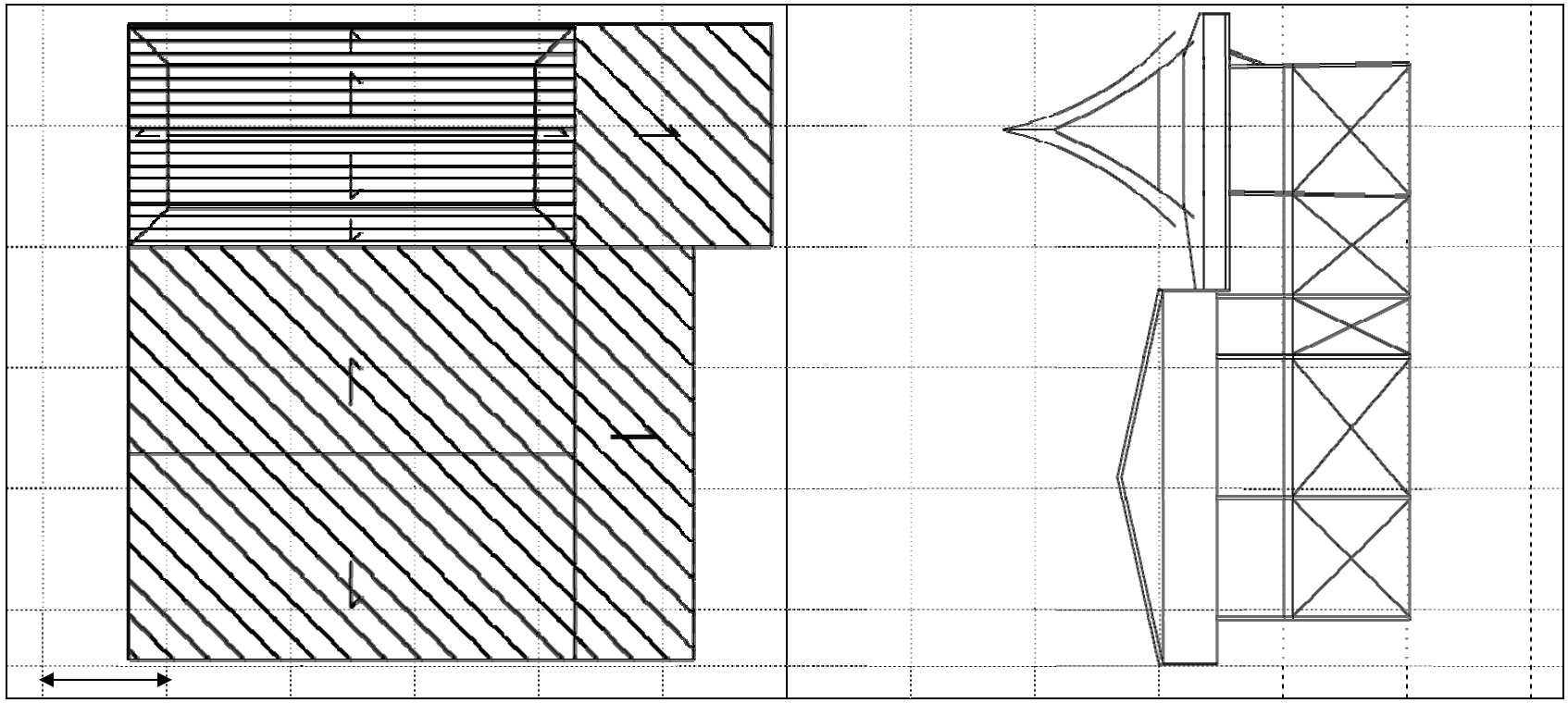
Upper Floor Column

Data				
	Original (In the beginning)	**1. Original with minor change (In the present)**	**2. Original with major change (In the present)**	**3. Expansion**
		Part No.	**Part No.**	**Part No.**
Materials	**Hard wood**	Hard wood	-	R.concrete R.concrete
Age/Year	1990	1979	-	1979 2002
Condition			-	 
Amount	8	4	-	
Sketch of Construction Detail				
				

Roof

Mat: Hard wood [Tradition] Hard wood [Truss]

Key Plan



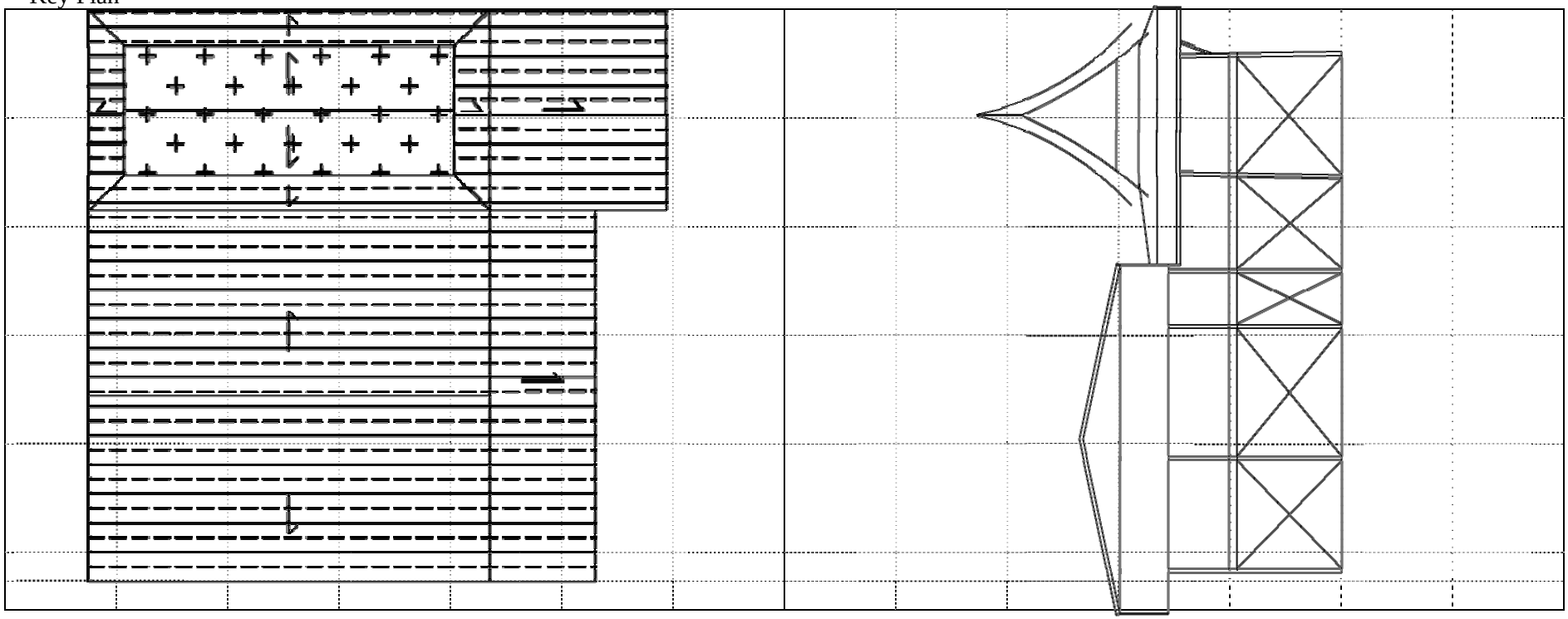
…3.. M

Ground Floor **Roof Elevation**

Roof

Mat: Corrugated Metal sheet Cement tile

Key Plan



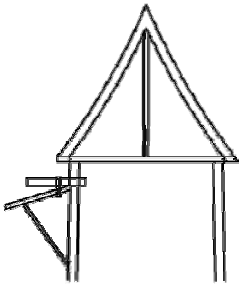
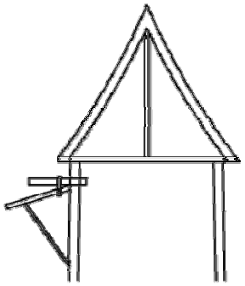
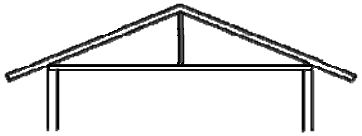
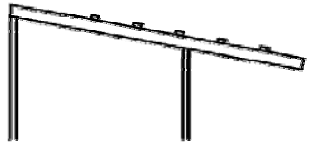
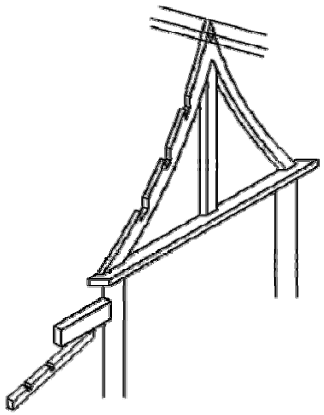
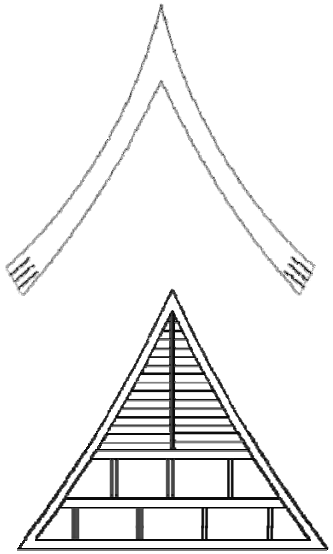
…3.. M.

Ground Floor

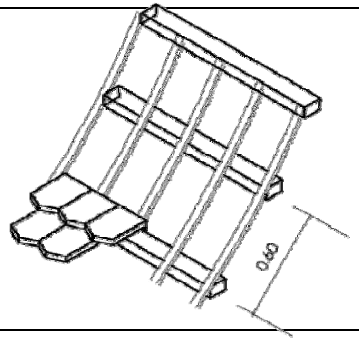
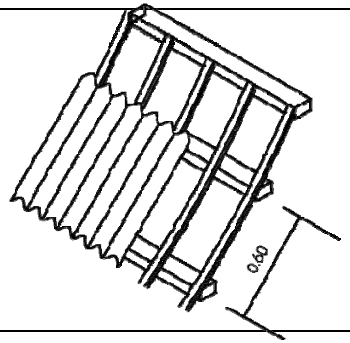
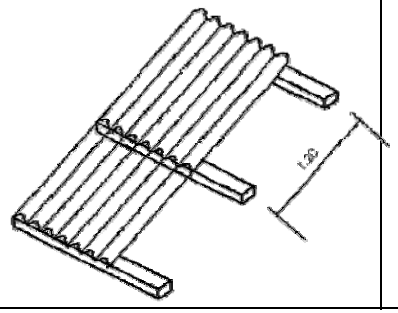
Roof Elevation

Roof Structure

Data				
	Original (At the beginning)	**1. Original with minor change (At the present)**	**2. Original with major change (At the present)**	**3. Expansion**
		Part No.	**Part No.**	**Part No.**
Materials	Hard wood	Hard wood	Hard wood	Hard wood
Age/Year	1900	1962	1979	2002
Condition				
Area		35%	40%	25%
Structural Type		Tradition	Truss	Truss
Span/Angle		60 degrees	20-30 degrees	20 degrees

Sketch of Construction Detail				
Cross Section				
Sketch of Construction Detail				
Frame Detail: Ridge Rafter Purlin Tied beam King Post H. Eave bracing V. Eave bracing **Barge Board** **Gable Pattern**				

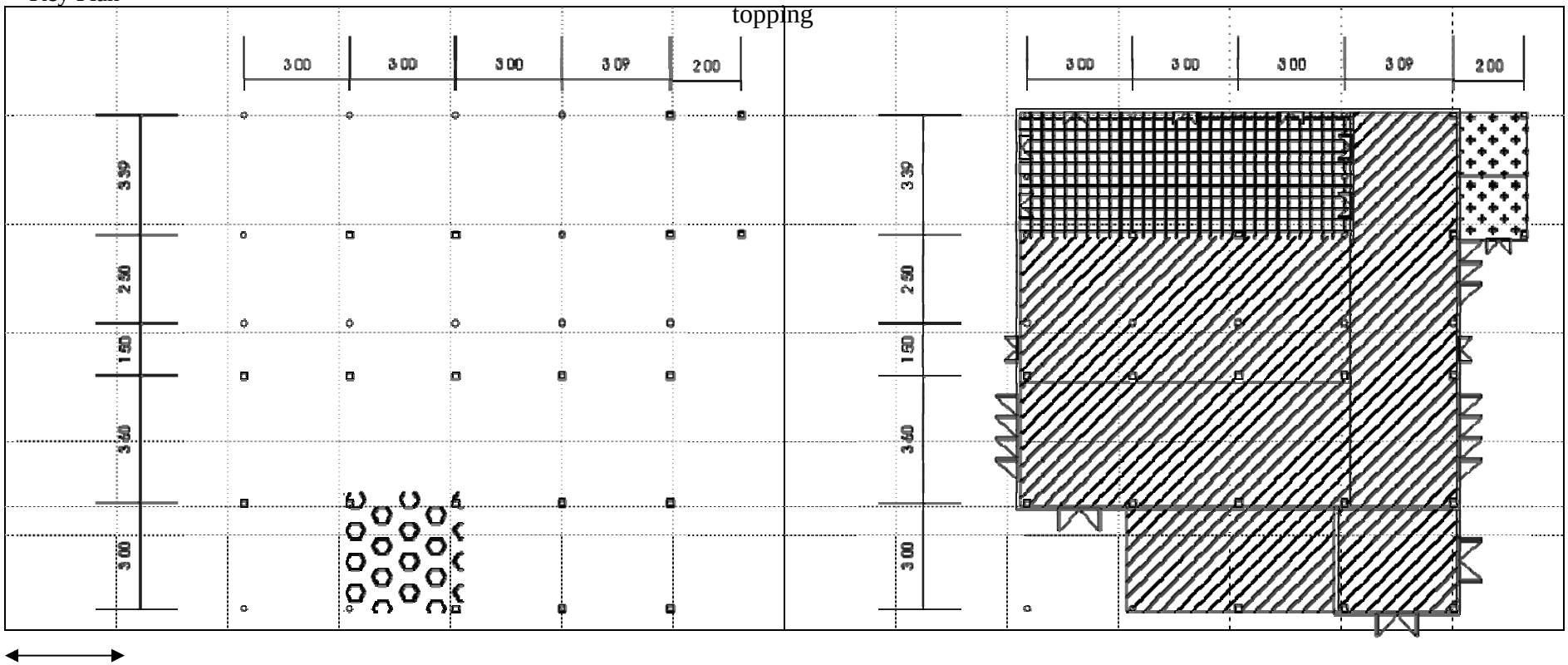
Roof Covering

Data					
	Original (At the beginning)	**1. Original with minor change (At the present)**		**2. Original with major change (At the present)**	**3. Expansion**
		Part No.		**Part No.**	**Part No.**
Materials	Clay tiles	Corrugated metal sheet	Cement tiles	Corrugated metal sheet	Corrugated metal sheet
Age/Year	1900	1962	1977	1979	2002
Condition					
Area					
Sketch of Construction Detail					
Pattern					
Covering Structure					

Floor

Mat: Compacted soil | Old hard Wood | New Hard Wood | R/C with ceramic tile topping | R/C only

Key Plan

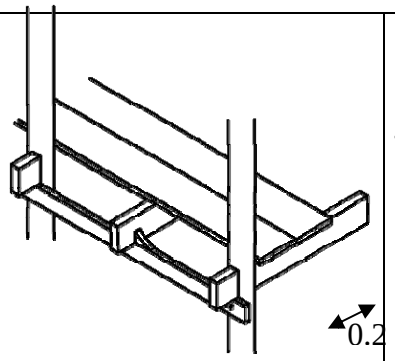
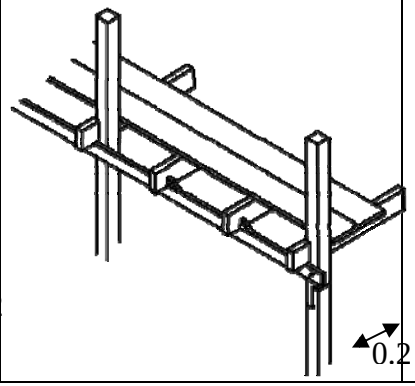
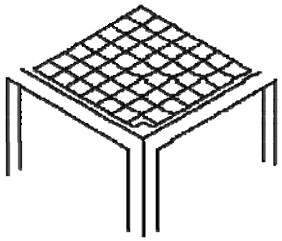


…3.. M.

Ground Floor

Upper Floor

Upper Floor

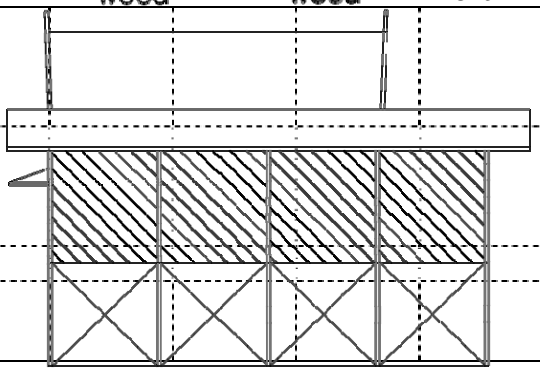
Data				
	Original (At the beginning)	**1. Original with minor change (At the present)**	**2. Original with major change (At the present)**	**3. Expansion**
		Part No.	**Part No.**	**Part No.**
Materials	**Hard wood**	**Hard wood**	-	**R.Concrete**
Age/Year	1900	1979	-	2002
Condition			-	
Area			-	
Sketch of Construction Detail				
				

Wall

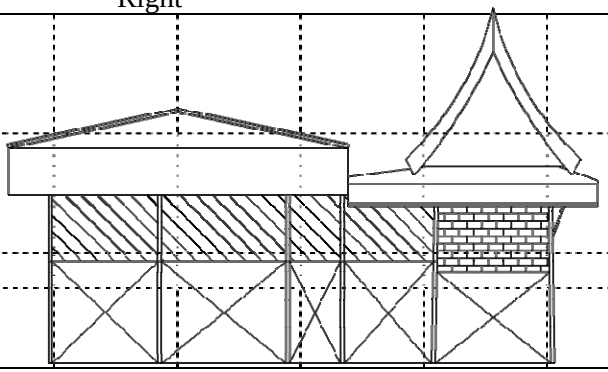
Mat:

Old hard wood | New hard wood | Brick

Front

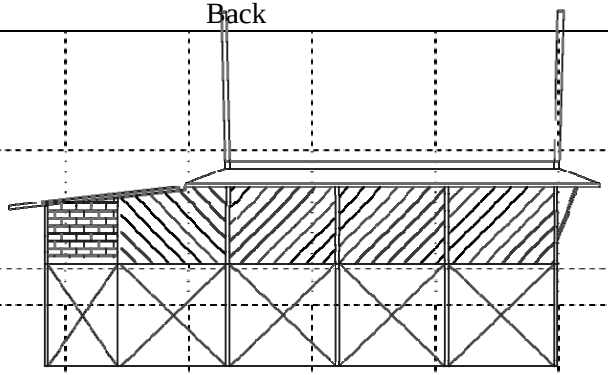


Right

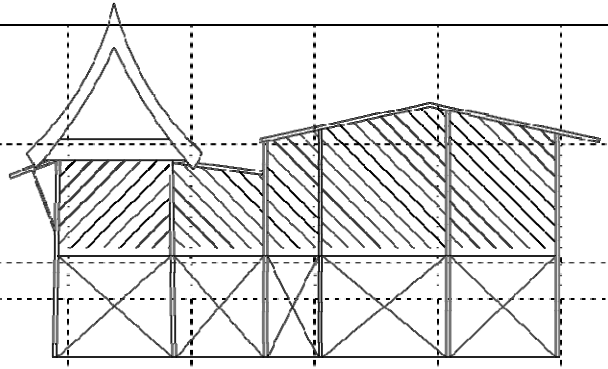


…3. M.

Back

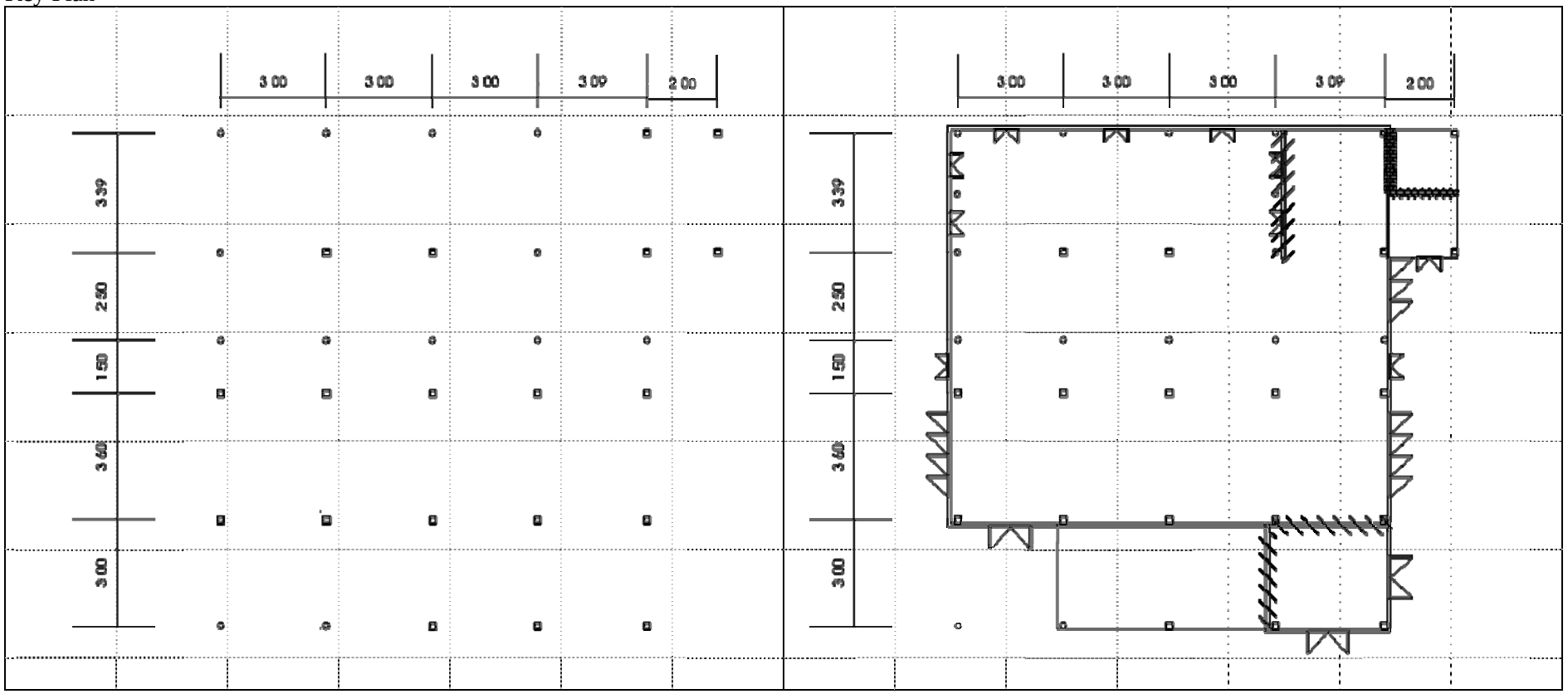


Left



Partition and Internal Wall

Key Plan



…3.. M.

Ground Floor

Upper Floor

Upper Floor

Data				
	Original (At the beginning)	**1. Original with minor change (At the present)**	**2. Original with major change (At the present)**	**3. Expansion**
		Part No.	**Part No.**	**Part No.**
Materials	Hard wood	New Hard wood	-	R. Concrete
Age/Year	1900	1979	-	
Condition			-	
Area	35%	65%	-	10%
Sketch of Construction Detail